THE ROLE OF PUBLIC PROGRAMS IN THE PRODUCTION OF HEALTH: AN EVALUATION OF THE IMPACT OF THE IMPROVED PREGNANCY OUTCOME PROGRAM ON BIRTH OUTCOMES IN FLORIDA

By

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For my father,

Douglas J. Clarke
(1924-1988)

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Because of the high costs of prenatal care and delivery services in the United States today, over 500,000 infants are born each year to women who have had inadequate or no prenatal care. These women who are unable to obtain adequate prenatal care are typically poor, young, non-white, and of low educational status; all of which places them at an increased risk of having a premature or low birth weight infant. Because the costs of these outcomes, in terms of medical and long-term institutional care, are exceptionally high, increased focus has been placed in recent years on the effectiveness of various public programs aimed at preventing these outcomes. This study is an evaluation of one such program--the Improved Pregnancy

Outcome (IPO) Program--and its role in reducing excessively high rates of these birth consequences in Florida.

Using linked birth and infant death certificate data, along with county program, sociodemographic and medical information, structural equation models are estimated to evaluate the role of the IPO on sub-optimal birth outcomes while controlling for other relevant factors. These models indicate that the IPO program does not have a significant direct impact on rates of prematurity, low birth weight, or neonatal mortality at the county level. The second part of the analysis compares birth outcomes of IPO women with a synthetic, matched-control group of non-IPO participants with similar risk characteristics. These results suggest that the IPO program is effective in reducing rates of low birth weight among black IPO participants and in reducing rates of neonatal mortality among both black and white IPO participants. These results are interpreted as indications of the IPO program's effectiveness in significantly improving the birth outcomes of the program participants, and, less significantly reducing overall county rates. In conclusion, support for the program's continuation is provided, and information concerning the significant role of other factors, such as family planning services, public education and teenage childbearing, on producing sub-optimal birth outcomes is presented to guide future research and policy-making.

CHAPTER ONE
STATEMENT OF THE PROBLEM

The problem addressed by this research is the high incidence of sub-optimal birth outcomes in the United States. Sub-optimal birth outcomes refer to those births characterized as premature (birth before 37 weeks of gestation), or low weight (weight less than 1500 grams, approximately 5.5 pounds), or that result in an infant death in the first year of life (i.e., infant mortality). These birth conditions are sufficient to warrant public concern and scientific inquiry for many reasons. Specifically, the reduction of sub-optimal birth outcomes is desired because of the high personal, medical and long-term care costs to individuals and society associated with these outcomes. Moreover, because prematurity, low birth weight, and infant mortality are believed to be amenable to public health interventions, recent deceleration in the downward trends of these outcomes is especially distressing to public health planners and policy-makers.

Prenatal care is believed to be one of the most practical and effective means of reducing the risks of sub-optimal birth outcomes in the United States (Institute of Medicine, 1985, 1988). It is commonly assumed that "Prenatal care is the single most significant determinant

of a newborn's health, influencing the role that biological, social and psychological factors play" (Southern Regional Task Force, 1985, p. 12). Yet the empirical evidence on this relationship is largely contradictory or inconclusive (Shadish and Reis, 1984). The major reasons for this lack of definitive evidence concerning the effects of prenatal care are related to data or methodological limitations, such as inadequate data (i.e., lack of outcome data linked to individual risk factors) or insufficient controls for confounding factors. The purpose of this research is to overcome these limitations and to assess the relationship between prenatal care and sub-optimal birth outcomes. Specifically, the purpose of this research is to evaluate the effectiveness of a public prenatal care program, Florida's Improved Pregnancy Outcome (IPO) program, in reducing county-level and participant rates of prematurity, low birth weight and neonatal mortality (death to infants less than 28 days). As the component of infant mortality that is typically due to maternal or medical factors (i.e., as compared to post-neonatal mortality--infant death between 28 days and 1 year of life--which is most often due to environmental factors), neonatal mortality is used because it is highly related to prematurity and low birth weight, and because it is more sensitive to prenatal interventions.

This evaluation of the IPO is undertaken for a number of reasons. Most importantly, the implementation of the IPO program by the state of Florida provides an opportunity to examine the widespread claim that adequate prenatal care for low income women reduces the incidence of sub-optimal birth outcomes (Institute of Medicine, 1988). In addition, evaluations of statewide public programs, particularly those similar to the IPO that consume a significant proportion of state general revenues, are critical to the effective governance of public resources. For example, if the program is found to play a significant role in reducing the rates of sub-optimal birth outcomes, then continued funding of Florida's IPO program and the development of similar public, prenatal care programs in other states may be warranted. If, on the other hand, the program is not found to reduce these rates, or if other policy-malleable variables are found to have a greater impact than the IPO, then new knowledge critical to national maternal and infant health policy will have been created. In either case, this study will have important implications for public health policy.

This chapter discusses the background and significance of this study. Following an overview of the study's rationale, trends in sub-optimal birth outcomes in the U.S. and in Florida and the consequences of these trends are presented. Following this, an overview of the etiology of

sub-optimal birth outcomes and the health services believed to be effective in reducing the risks of these outcomes are discussed. The final section of this chapter is a summary of the research strategy employed and a brief description of the dissertation's organization.

Overview and Significance of Study

The purpose of this study is to evaluate the effectiveness of Florida's statewide public prenatal care program in reducing rates of prematurity, low birth weight and neonatal mortality. Florida's IPO program is selected for study for three reasons. First, the IPO is one of the few statewide, public maternity care programs in the nation. Most other states with public maternity services have limited delivery areas, are implemented only in selected cities or among specific at-risk populations, or offer a restricted number of services. Florida's IPO program, by comparison, delivers comprehensive prenatal care services in each of the state's 67 counties.

Secondly, Florida's IPO program is of interest because it has been implemented in a state that has had historically higher than average rates of low birth weight and infant mortality. The availability of data that addresses the ability of the IPO program to improve birth outcomes among high risk women should provide important information for program development both statewide and nationally.

Third, the IPO program was initiated with federal funds designated for the implementation of demonstration programs in states with higher than average rates of sub-optimal birth outcomes. Yet, few comprehensive analyses of IPO programs have been undertaken or are widely available (Strobino, 1984). The effectiveness of such programs is critical, however, to federal policy-makers concerned with program relevance, as well as to state law makers who must decide whether to continue funding a program that currently costs in excess of $34 million annually in Florida. These facts combine to make an evaluation of Florida's IPO program sociologically and academically interesting, as well as policy-relevant.

The next section examines the nature and extent of the problem of sub-optimal birth outcomes in the United States and in Florida. After describing the historical trends, the consequences of sub-optimal birth outcomes are reviewed.

The Problem of Sub-Optimal Birth Outcomes in the U.S. and Florida

National and sub-population rates of prematurity, low birth weight and infant mortality are key statistics to health planners and policy-makers. A nation's rate of infant mortality has long been regarded as a sensitive indicator of a country's level of economic development and social equality (Pampel and Pillai, 1986). As with any

demographic indicator, however, it is important to interpret its significance both historically and comparatively. The following discussion reviews the rates of selected sub-optimal birth outcomes in the United States and in Florida over time, and compares these to other relevant geographical units.

U.S. Trends in Sub-Optimal Birth Outcomes

In the eighty years between 1900 and 1980 the rate of infant mortality in the U.S. declined precipitously from 162 per 1000 live births in 1900 to 12.6 per 1000 live births in 1980 (Children's Defense Fund, 1989). During the 1980's, however, the rate of infant mortality slowed in its decline. Between 1980 and 1986, the national rate of infant mortality slowed from 3.7% or greater annual declines, to 2.9% annually (Children's Defense Fund, 1989). Moreover, the most recent official figures indicate that there has been essentially no change in the infant mortality rate between 1988 and 1989 (National Center for Health Statistics, November 30, 1989).

The U.S. does not compare well to other developed nations on rates of infant mortality. For example, Japan and Sweden have infant mortality rates below 5 per 1,000 births compared to the U.S. rate of 10.0 (Committee for the Prevention of Infant Mortality, 1987). Moreover, the U.S. has dropped from being 15th ranked among developed nations

to 19th in 1988 (Children's Defense Fund, 1990a). In addition, if the U.S. rates of infant mortality among sub-populations were compared to other nations, the U.S. would rank far lower than it currently does. For example, the U.S. would rank lower than Costa Rica and Hungary, well below 28th in the world, if the U.S. rate of infant mortality among blacks (18 per 1,000 in 1986) was compared (Children's Defense Fund, 1989).

Figure 1-1 is a graphical depiction of the overall and race-specific rates of infant mortality in the U.S. between 1940 and 1987. This figure highlights the decelerated decline in the infant mortality rate in the recent decade. Following fairly constant declines since the 1950s, the recent U.S. infant mortality rates are beginning to level out--a trend neither desired nor understood.

Even more dramatic are the data showing that the U.S. rates of prematurity and low birth weight, which had been consistently trending downward, are reversing their direction. For example, between 1981 and 1986 prematurity rates <u>increased</u> to over 10% of all births, while low birth weight rates remained stagnant at approximately 7.9% (Children's Defense Fund, 1989). Compared to other nations, the U.S. is ranked 29th in the world for its rate of low birth weight (Children's Defense Fund, 1990a).

The interpretation of these demographic trends is that fewer infants are being born healthy and are surviving the

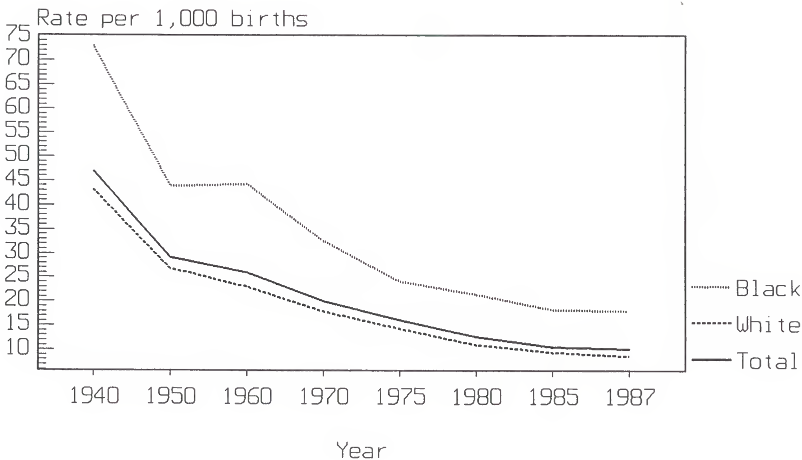

Figure 1-1: Infant Mortality Rates Among the Total, Black, and White Populations in the United States, 1940-1987

first year of life than would be true if the historical declines in these rates had continued throughout the 1980s. In both absolute and relative terms, therefore, infant mortality is viewed as unnecessarily high in the United States. These changes have raised increased concern among public health officials.

The concern expressed by policy makers is manifested in the development of the 1990 Objectives for National Health set by the U.S. Surgeon General (Health and Human Services, 1986) and, more specifically, in the formation of the National Commission to Prevent Infant Mortality (National Commission, 1987). Among many other health objectives, the Surgeon General set forth a number of goals related to maternal and infant health. These include (1) the reduction of total infant mortality to no more than nine infant deaths per 1,000 live births each year; (2) the reduction of county, racial, or ethnic population (e.g., black, hispanic) rates of infant mortality to no more than 12 deaths per 1,000 live births; (3) the reduction of overall low birth weight rates to less than 5% of all births; and (4) the reduction of county, racial, and ethnic population low birth weight rates to no more than 9% (Koontz, 1984).

The National Commission to Prevent Infant Mortality, established in 1987, was an effort by Congress to aid in the achievement of the aforementioned goals established in

the 1990 'objectives' by discharging a commission with the task of disseminating information on the problem and means of reducing infant mortality in the U.S. The development of these national objectives and the formation of the Commission to Prevent Infant Mortality are activities that illustrate some of the national initiatives undertaken in recent years to try to reduce the nation's high rates of sub-optimal birth outcomes.

Dramatic improvement in the reduction of sub-optimal birth outcomes, however, do not seem imminent. Although the goals for the overall and white rates of infant mortality in the U.S. may be met by the end of the 1990s, it is projected that the objectives for the black and total non-white rates of infant mortality in the country will not be met (Centers for Disease Control, 1988). In 1987, the infant mortality rate for blacks was 17.9. This was the third year in a row that there was no significant improvement among blacks. Among the total nonwhite population the infant mortality rate was 15.7 per 1,000 births in 1987. By comparison, the white infant mortality rate dropped from 8.9 to 8.6 between 1986 and 1987. Thus, the gap between black and white birth outcomes remains greater than 2 to 1 (Children's Defense Fund, 1990b). It appears, therefore, that the national initiatives to reduce rates of infant mortality have not been entirely successful nor have improvements been equitably distributed.

At the state level, sub-optimal birth outcome statistics expose additional mortality disparities. Although the U.S. infant mortality rate has declined during the 1980s, in fifteen states infant mortality rates <u>increased</u> between 1985 and 1986 (Children's Defense Fund, 1989). In Alabama, for example, the infant mortality rate increased 18%, and in South Dakota it jumped 34% during this time period.

In addition, different regions of the country experience unequal rates of infant mortality. In particular, discrepancies between the southern and the northeastern states are the most notable. In 1987 the nation's highest overall infant mortality rates were concentrated in the southern states (Children's Defense Fund, 1990b). The rates of infant mortality in the southern states (i.e., those running from Texas, across the South and up into Virginia) are so much higher than other parts of the nation that this region has earned the label, the "Infant Mortality Belt" (Southern Legislative Research Council, 1989).

Because of these regional and population-specific trends in sub-optimal birth outcomes, it is critical to examine separately the states and populations that experience increased risk of these problems. In this study Florida is selected as the state of interest because of its

location in the South and because of its historically high rates of sub-optimal birth outcomes.

Florida Trends in Sub-Optimal Birth Outcomes

Florida's infant mortality rate has placed the state in the lower quartile of U.S. states based on infant deaths for the two decades prior to 1987 (Children's Defense Fund, 1989). In 1987 Florida's low birth weight rate of 7.7% placed the state 39th in the nation. Moreover, in 1986, Florida's rate of black infant mortality (18.2) was higher than all other southern states' rates except Alabama (20.0) and Tennessee (18.6) (Southern Legislative Research Council, 1989). Florida has also consistently ranked in the lower quartile of all states for its rates of low birth weight and inadequate prenatal care (Children's Defense Fund, 1989).

In 1987, Florida's infant mortality rate was 10.6 overall, ranking the state 38th in the country. Figure 1-2 presents a graph of Florida's trends in infant mortality and low birth weight for selected years between 1977 and 1987 to provide a visual depiction of Florida's experience. This figure shows downward trending similar to national trends. However, Florida's rates are consistently higher than the national rates on these indicators. The next section of this chapter discusses the economic and societal consequences of the statistics just reviewed.

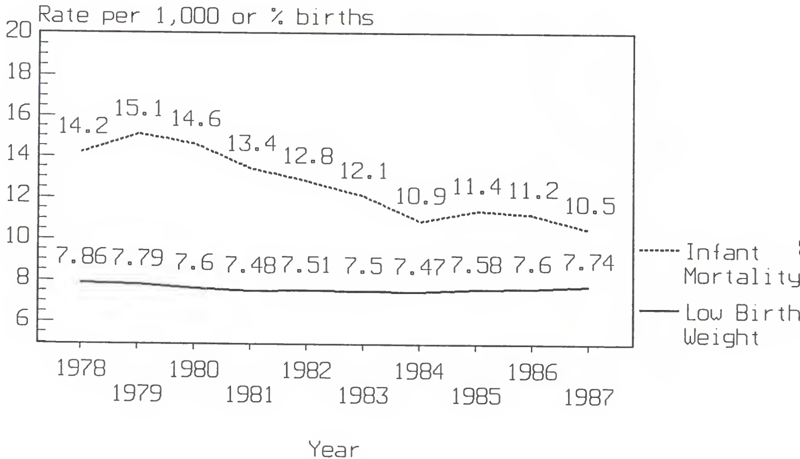

Figure 1-2: Infant Mortality and Low Birth Weight Rates in Florida, 1978-1987

The Consequences of Sub-Optimal Birth Outcomes

Beyond the personal tragedy and emotional costs of losing an infant or caring for a disabled child, the birth outcomes studied here are of great significance to society in terms of human capital and medical care costs. The current infant mortality rate of approximately 10 per 1,000 live births translates into the loss of over 38,000 infants each year, many of whom should have survived and could have been productive members of society.

From a human capital perspective the costs of these lives can be calculated using Rice's (1966) formulation for the costs of lifetime earnings foregone due to death. Using the figure of 38,000 deaths, the human capital costs of annual infant deaths to society are roughly estimated at over 12 billion dollars[1].

In terms of medical costs the U.S. spends between $14,000 - $30,000 in the first months of life, and an average of $400,000 over the course of a lifetime for infants born prematurely or of low birth weight (National Commission to Prevent Infant Mortality, 1987). These costs are associated with the high incidence of congenital

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[1] Calculating the value of a life or the lifetime earnings of an individual, discounted at four percent, was $58,879 for a male and $36,234 for a female less than one year of age, in 1964 (Rice and Cooper, 1967). A crude approximation of the total human capital or discounted lifetime earnings lost to society due to infant deaths in 1989 was calculated using the 1964 figures and attributing half the deaths as male and half as females.

anomalies, neurodevelopmental handicaps, and subsequent developmental problems common among premature and low birth weight infants (Institute of Medicine, 1985). In addition, most premature infants and many low birth weight infants require neonatal intensive and other extensive medical care. The costs of providing medical treatment to these infants is often 10 times the cost of care for a healthy child. For example, the average hospital costs for an infant weighing 1000-1499 grams (approximately 3 pounds or less) are $36,153 (U.S. Congress, Office of Technology Assessment, 1987). Estimates of the costs of care for premature infants who receive neonatal intensive care range from $19,800 (Phibbs, Williams, & Phibbs, 1981) to $62,730 (Pomerance, Schifrin, & Meredith, 1980). At an aggregate level, the U.S Congress Office of Technology Assessment (1987) estimates that the annual cost of neonatal intensive care in the U.S. exceeds $1.5 billion. Moreover, premature and low birth weight infants who survive neonatal intensive care typically require long-term institutionalization.

It is argued that, because insufficient prenatal care contributes to sub-optimal birth outcomes and subsequent morbidity, the lack of universal access to prenatal care in the U.S. is costly to the country. Estimates of the costs averted by investing in prenatal care range from two to ten dollars in savings for every one dollar spent on prenatal care (American Academy of Pediatrics, 1984). Moreover,

because low income and poorly educated women are at an increased risk of bearing a low birth weight infant, it is estimated that each dollar spent on providing prenatal care to these women would result in a savings of $3.38 during the first year of life (Institute of Medicine, 1988). Therefore, when the costs of providing prenatal care are compared to the costs of neonatal intensive care, the savings appear dramatic. For example, the costs of providing prenatal care to 3,000 women are estimated to be approximately $858,000, compared to $2.5 million for the provision of neonatal intensive care to the infants of 3,000 women without prenatal care (Southern Regional Task Force, 1985).

Declining improvements in the rates of prematurity, low birth weight and infant mortality, therefore, translate into increasing medical care expenditures and long-term care costs for families and for the nation. For these reasons, the study of the social services, programs, or policies that may play a role in reducing the incidence of these outcomes is critical. To provide an overview of the individual and structural variables known to contribute to the risk of sub-optimal birth outcomes, a review of these factors, as well as a brief discussion of prenatal care and other programs in the U.S. believed to reduce these risks, is presented next.

Factors Associated with Sub-Optimal Birth Outcomes

Many individual and structural variables have been identified as correlates of poor birth outcomes. These variables are generally grouped into three major categories: biological, sociodemographic, and medical risk characteristics.

Biological factors known to be associated with poor birth outcomes including maternal characteristics, such as short stature or genetic disorders, are typically not amenable to social intervention. Sociodemographic variables include individual-level maternal and county structural characteristics, such as maternal age, median education, and poverty. Though the focus of much research, many of these characteristics are not directly addressed by social interventions concerned with reducing sub-optimal birth outcomes.

Variables included in the medical category include those that affect birth outcomes by influencing maternal and infant health both directly and indirectly. These include factors such as lack of access to medical care, multiple abortions, or inadequate prenatal care (Institute of Medicine, 1985). These medical variables are more generally amenable to social intervention and treatment and are, therefore, the focus of most federal resources and research aimed at alleviating infant mortality.

Prenatal Care and Other Programs Aimed at Reducing Sub-Optimal Birth Outcomes in the U.S.

As noted earlier, it is widely believed that the high rates of sub-optimal birth outcomes in the United States could be reduced through the provision of adequate prenatal care to women in need (Children's Defense Fund, 1989; Institute of Medicine, 1988; National Commission, 1987). This assumption is based on the research that suggests that adequate prenatal care, characterized as early entry to medical care (i.e., in the first trimester of pregnancy) and successive obstetrical visits (i.e., at least 10 visits to an obstetrician or nurse), are associated with reduced rates of prematurity, low birth weight, and neonatal mortality (Institute of Medicine, 1988; McCormick, 1985).

The components of prenatal care that are believed to improve maternal and infant health are clinical assessments by an obstetrician or general practitioner, health and nutrition education, and monitoring of the fetal growth. In particular, the health education concerning proper nutrition, exercise, and preparation for delivery are believed to reduce the risks of premature and low birth weight infants.

Because of these expected relationships, universal access to prenatal care is viewed as an important component of public health policy. However, thousands of pregnant women are not able to obtain adequate prenatal care in the U.S. each year. In 1986, approximately 34% or 1.3 million

pregnant women received insufficient prenatal care (Alan Guttmacher Institute, 1987).

The primary reason women do not access prenatal care is because they cannot afford it (Institute of Medicine, 1988). Childbearing is a costly experience in the United States. The cost for a normal pregnancy and delivery in the U.S. averages $4,334 (Health Insurance Association of American, 1989). For a cesarean section delivery, which accounts for nearly one million deliveries a year, total costs average $7,186 (Health Insurance Association of America, 1989).

Due to the high costs associated with prenatal care, as well as inadequate access to health services because of such things as overburdened clinics or inadequate Medicaid coverage, between 5% and 10% of all pregnant women receive no prenatal care (Southern Regional Task Force, 1985). Moreover, the percentage of pregnant women unable to obtain or pay for prenatal care has increased in recent years. As a result, millions of pregnant women turn to public maternity services or they go without prenatal care.

To improve the access of poor and uninsured women to prenatal care, state and national policies have been focused in recent years on expanding prenatal care services to reach more women. One of the most significant efforts has been the 1976 Congressional funding of the Improved Pregnancy Outcome (IPO) program. This program was

developed to expand the provision of comprehensive maternity services to poor women and to improve rates of sub-optimal birth outcomes in the country. Initially 13 states with higher than average rates of infant and neonatal mortality were given IPO funds to develop demonstration projects. This program and its effectiveness in Florida are the focus of this research.

Prior to the implementation of the IPO program, the federal Maternal and Infant Care (MIC) projects were the primary resources aimed at providing states funds for public maternity care. These projects were similar in intent and design to the IPO program. Medicaid expansions to cover pregnant women and the Special Supplemental Food Program for Women, Infants and Children (WIC) are additional federal programs funded in recent years to improve maternal and infant health. These programs provide both medical care and nutritional services to pregnant women who meet income eligibility requirements. Finally, family planning and abortion services have also been found to reduce the risks of sub-optimal birth outcomes, primarily by preventing unwanted pregnancies.

Research Strategy

The focus of this research is on prenatal care and its ability to reduce the incidence of prematurity, low birth weight and neonatal mortality. To estimate the impact of the IPO program on the rates of sub-optimal birth outcomes

in Florida, data were gathered at the individual-level (i.e., maternal and infant characteristics), including IPO participant data, and the county-level (e.g., county rates of poverty, public program participation, and medical service availability). These data were gathered for the 1985-1988 time period both because these are the most recently available data and because they cover each year of the program since it was expanded statewide in late 1984. Data on maternal characteristics, county sociodemographics, medical services and public programs were also gathered to allow for an assessment of the IPO's impact while controlling for key intervening factors.

Two separate but complementary analyses are undertaken. The first is the estimation of structural equation models specified to predict rates of prematurity, low birth weight, and neonatal mortality at the county level in a hierarchical, recursive system. Due to the small numbers of these birth outcomes in the smaller counties in Florida, three years (1986-1988) of outcome data are pooled to provide stable estimates of model parameters. Race-specific models are estimated because of the known disparities in birth outcomes between whites and blacks (as will be documented in detail subsequently). The results will provide evidence regarding the role that the IPO plays in the reduction of sub-optimal birth outcomes at the

county level with the effects of other variables controlled.

The second analysis will compare the rates of birth outcomes among IPO participants, a matched comparison group, a residual group, and total state rates. Because the creation of a pure experimental control group (i.e., women who are similar to IPO program participants on key characteristics but who are denied access to prenatal care) is an impractical and unethical research strategy, a synthetic comparison group was created to serve as a population against which the IPO participant outcomes could be compared. Based on frequency distributions of IPO women across simultaneous categories of race, maternal age, education, marital status and prenatal visits, this comparison group was randomly drawn from the population of non-IPO participants in proportions equivalent to the IPO group. The results of contrasting these groups over the 1985-1988 time period will provide further evidence of the impact, or lack thereof, of the IPO program on birth outcomes among participants. Since the IPO program is available only to low-income (i.e., less than 150% of poverty) women, this latter analysis is expected to be more sensitive than the former to any effects of the IPO program. However, if the IPO is found to significantly impact county-wide rates of sub-optimal birth outcomes, then greater confidence can be placed in the conclusion

that the IPO program plays a role in improving birth outcomes.

The remainder of this manuscript will be organized in a manner similar to this overview chapter. Chapter Two is a review of the literature on the etiology of sub-optimal birth outcomes and the health services believed to reduce the risks of these outcomes. Chapter Three describes the IPO program in detail. Chapter Four is a description of the data and methods used. Chapters Five and Six present the findings for each of the two analyses undertaken, and Chapter Seven is a discussion of the results and implications of this study.

CHAPTER TWO
A REVIEW OF THE LITERATURE RELATED TO SUB-OPTIMAL BIRTH OUTCOMES

The academic literature on pregnancy and birth outcomes is prodigious, covering issues ranging from the biological and clinical aspects of reproduction to the social correlates of adverse birth outcomes. This chapter reviews and discusses the research concerned primarily with non-clinical events, including health and social factors that increase the risks of sub-optimal birth outcomes and the medical and social interventions found to reduce these risks.

The chapter is divided into four main sections. The first section identifies the sub-optimal birth outcomes that are selected as dependent variables and discusses the rationale for their inclusion in this research. Following this, an overview of risk factors that increase the incidence of these outcomes is presented. The third section describes the social and medical interventions (i.e., public welfare programs) that have been identified as important to the reduction of the rates of these birth outcomes. The final section reviews the literature on the etiology of each condition, including references to the risk factors and interventions that affect their incidence.

Measures of Sub-Optimal Birth Outcomes

In the literature on pregnancy outcomes, three measures of sub-optimal birth consequences are commonly used. These measures are (1) the prematurity rate--the number of infants born before the 37th week of gestation as a proportion of all live births; (2) the low birth weight rate--the number of infants born weighing less than 5.5 pounds as a percent of all live births; and (3) the infant mortality rate. The infant mortality rate is composed of the neonatal mortality rate--the number of infants that die within the first 28 days of life as a proportion of live births--and the post-neonatal mortality rate--the number of infants that die between 28 and 365 days after birth. These indicators are expressed as rates observed in a calendar year, either as a percent of live births (as in the case of low birth weight), or as a rate per 1,000 live births (as with prematurity and neonatal mortality).

Because of their utility as indicators of a nation's standard of living and health status (Pampel & Pillai, 1986), these statistics are routinely collected and reported throughout the world. As a result, these indicators have been widely researched and are accepted as relevant measures of maternal health and population well-being in both academic and political arenas.

In this study, prematurity, low birth weight, and neonatal mortality rates are selected as the dependent

variables of interest. There are two key reasons that I chose these variables as outcome indicators. The first is that reductions in these rates have been targeted by the State Health Office as goals toward which the Florida IPO program's efforts are directed. In fact, the diminution of state-level rates of prematurity, low birth weight, and neonatal mortality is one of the main reasons the IPO was initially implemented. The second reason for their selection corresponds to the interrelatedness of these measures. Specifically, because premature infants are usually of low birth weight, and because low birth weight and premature infants have greatly increased risks of dying in the first month of life (Institute of Medicine, 1985; Starfield, 1985), the inclusion of all three indicators allows for the modelling of the structural relationship among these outcomes. The inclusion of all three measures, therefore, should produce results that are more valid than if these outcomes were analyzed without consideration of their structural intercorrelations, and it will reduce the error associated with the model estimation (i.e., that which results from omitting relevant variables).

Sub-Optimal Birth Outcome Risk Factors

Numerous risk factors have been identified as being correlated with or causing increased rates of poor birth outcomes. These characteristics are commonly grouped into

categories based on similarities of factor source or impact. In this research, two major groupings of risk factors are utilized. These categories are (1) <u>sociodemographic risk factors</u>, which include <u>socioeconomic variables</u>, such as poverty status and education levels, and <u>demographic risk characteristics</u> such as race and age; and (2) <u>health/medical risk factors</u> (which will be referred to simply as 'medical' risk factors) including <u>health related risks</u> such as alcohol use, and <u>medical factors</u> such as inadequate prenatal care or limited access to neonatal intensive care.

These variables are discussed within these categories both for the sake of parsimony and to highlight their common sources and operations. For example, all of the sociodemographic variables relate to individual (or aggregated) characteristics that are socially produced (e.g., education levels) and that operate to determine the health-related knowledge and behaviors of pregnant women. This knowledge, in turn, determines the behavioral choices a pregnant woman makes that will impact the health of her infant. Though the paths of the sociodemographic variables on infant survival have not all been empirically confirmed, the causal assumption propounded in most of the literature is the following. Because low education, single marital status, poverty, and public welfare program participation are correlated with poorer nutritional status, housing

conditions, and health behavior, and because poor nutrition, housing, and income are associated with higher rates of low birth weight and infant mortality, then the paths of the sociodemographic effects on maternal and infant health must operate similarly through maternal nutritional status, living conditions, and health behavior.

The path of medical variables on sub-optimal birth outcomes is more explicit because of the nature of and ability to control these variables. In particular, the research on the ability of neonatal intensive care utilization to improve the survival rates of premature and low birth weight infants is broad and conclusive. The role of prenatal care in improving birth consequences, though convincing to some, remains controversial mainly because so many maternal risk factors, such as poverty and low education, are known to determine the start of and continuation of adequate prenatal care. Therefore, the disentanglement of these factors is more difficult than with other medical factors.

In subsequent sections, I provide more detailed discussion of the role of each risk variable on birth outcomes. This overview, however, should provide the perspective needed to understand the role of social and medical risk factors in the production of infant health. I now describe the public programs considered to be effective interventions in the reduction of these risks.

Interventions to Reduce the Risks of Sub-Optimal Birth Outcomes

To reduce the incidence of poor birth outcomes in the United States, a number of publicly funded programs to improve the health of pregnant women have been instituted in the last 60 years. For example, a study by the Institute of Medicine (1988) identified over 200 programs across the nation related to the provision of prenatal care. The U.S. programs designed to improve maternity services or access to prenatal care that have been selected for study here are Maternal and Infant Care (MIC) Projects, the Special Supplemental Food Program for Women and Children (WIC), Family Planning Services, Aid to Families with Dependent Children (AFDC) and Medicaid coverage for pregnant women and infants, and the Improved Pregnancy Outcome (IPO) Program. Because the IPO is the focus of the research, it will be described in detail in the next chapter.

Maternal and Infant Care (MIC) Projects

Legislated in 1963, federal MIC projects provide funding to states in order to reduce the effects of urban poverty on birth outcomes and child morbidity by expanding maternity care services. Though relatively few MIC projects are still in operation today, in 1972 there were 56 MIC projects in the U.S. (Shadish & Reis, 1984).

MIC services are provided to both eligible pregnant women and infants less than one year of age. Maternity

services available through MIC projects included free diagnostic and preventative services, such as nursing assessment, nutritional assessments and counseling, case management, and medical exams. Treatment services include physician and nurse midwife services, family planning exams and services, assistance in delivery arrangements, and parenting classes. MIC project maternity services are considered the most comprehensive available for improving the birth outcomes of pregnant women (Department of Health and Rehabilitative Services, 1981).

The research on the effectiveness of MIC projects in improving birth outcomes varies. A 1980 study of a Cleveland MIC project showed that MIC participants had 60% lower perinatal mortality than a control group of women with similar sociodemographic backgrounds (Sokol, Wolf, Rosen, & Weingarden, 1980). Studies of North Carolina's MIC project, however, report nonsignificant improvements in birth weight among MIC participants (Peoples, 1981), but decreased rates of low birth weight among high-risk subpopulations and improved rates of prenatal care (Peoples & Siegel, 1983).

In 1966 Florida received funding for MIC projects in five project areas, encompassing 17 counties (DHRS, 1987). These projects remained in operation until 1982 when federal funds were terminated and the IPO program continued and expanded services via state funds. In 1985, all public

maternity services in Florida were considered IPO, thus subsuming the MIC projects.

An evaluation of North Central Florida's MIC project has shown mixed results regarding the impact of the program on birth outcomes. While positive effects of the project on non-white perinatal mortality are reported, no improvements in birth weight or infant mortality were identified (Nell, Brady, & Gormley, 1986). The project was, however, reported to provide needed maternity services in an area with few medical resources and poor birth outcomes (North Central Florida Health Planning Council, 1982). In Florida, as in many states, MIC projects served an important part in the delivery of needed maternity care to poor women.

Special Supplemental Food Program for Women, Infants and Children (WIC)

The Special Supplemental Food Program for Women, Infants and Children, commonly referred to as WIC, was implemented in 1972 with the goal of improving the nutritional status of women, infants and children living below the poverty level. For pregnant women evaluated as at risk of nutritional deficiency, this program provides nutrition information and \$20 - \$30 worth of food vouchers each month. In 1989, approximately 3.4 million people in the U.S. were enrolled in the WIC program, at a cost of \$1.9 billion (New York Times, 1990).

In general, this program has been found to reduce adverse pregnancy outcomes (Metcoff, Costiloe, Crosby, Dutta, Sandstead, Milne, Bodwell and Majors, 1985). An evaluation of the participation rates and birth outcomes of women enrolled in the WIC program in Massachusetts, for example, showed that reduced rates of low birth weight and improvements in mean birth weight and gestational age are highly correlated with WIC participation (Kotelchuk, Schwartz, Anderka, & Finison, 1984). A study by Kennedy et al. (1982) also reported significant improvements in birth weight associated with increases in WIC participation.

WIC participation is also found to be of greatest value to women at high risk of adverse birth outcome: those poor, black and/or in their teenage years. A report recently released from the U.S. Agriculture Department indicates that "WIC improves the diet of pregnant women and children, adds to maternal weight gain, increases the use of prenatal care, and reduces preterm deliveries" (New York Times, 1990). Unfortunately, the national rate of participation in WIC is estimated at less than 21% of all eligible women. This study includes a measure of WIC participation rates to control for the effects of this variable and to examine the program's unique contribution to changes in birth outcomes.

Family Planning Services

Family planning services include any medical services, education, counseling, or prescribing related to

contraception or birth control. The impact of these services on improvements in birth outcomes is believed to operate through the prevention of unwanted pregnancies. Grossman & Jacobowitz (1981), for example, report that the increased use of family planning services by low-income women is the second most important factor in reduced rates of nonwhite neonatal deaths in New York City. For whites, the effect of family planning service utilization is less significant (Grossman & Jacobowitz, 1981).

AFDC and Medicaid

The Aid to Families with Dependent Children (AFDC) and Medicaid programs are important sources of support and funding for medical care for pregnant women and children. The AFDC program is useful primarily because pregnant enrollees are automatically eligible for Medicaid-covered prenatal care. Moreover, in some states, pregnant women may apply for AFDC benefits on behalf of their unborn children (Beeghley, 1985). However, the eligibility requirements and paperwork involved in applying for AFDC or Medicaid are known to discourage many eligibles from applying.

Nevertheless, approximately 542,000 deliveries--about 15% of all births--are subsidized by Medicaid each year at a cost of almost $1.2 billion annually (Kenney, Torres, Dittes, & Macias, 1986). Fortunately for pregnant women, Congress acted in 1986 to allow states the option of

providing Medicaid eligibility to pregnant women and infants whose incomes are above the states' AFDC/Medicaid eligibility limits but below 100% of poverty (Southern Governors Association, 1988). Referred to as the SOBRA (Sixth Omnibus Budget Reconciliation Act) expansion, this option is viewed as legislation critical to the provision of medical care for indigent pregnant women. In 1987, Congress further expanded Medicaid limits for pregnant women, allowing states to raise eligibility levels to 185% of poverty. However, few states have taken advantage of this option. In 1988, Massachusetts was the only state to offer statewide Medicaid coverage to all pregnant women under 185% of poverty (Rosenbaum, Hughes, & Johnson, 1988).

The expansion of Medicaid services has not improved access to prenatal care for all women. Regional shortages of nurses and resources and the obstetrical malpractice climate continue to deplete the availability of public health services and the number of obstetricians willing to accept Medicaid patients. In 1986, the percentage of Medicaid recipients and uninsured women with insufficient prenatal care ranged from 14% to 82% across the United States. Over 50% of Medicaid recipients in two-thirds of the communities studied, obtained insufficient prenatal care (U.S. General Accounting Office, 1987).

In Florida, Medicaid is an important funding stream for maternity services. In all clinics that provide IPO

services the goal of enrolling eligible women in Medicaid is primary during the initiation of prenatal care. The more successfult counties are in receiving reimbursement from Medicaid for services, the more able they are to provide care to women who are not Medicaid enrollees. Medicaid is therefore viewed as an important component of the provision of maternity services through the IPO program to low income women in Florida. For these reasons, a measure of county-level Medicaid participation rates is included in this study.

The literature related to prematurity, low birth weight and neonatal mortality and their etiologies is summarized below. These summaries include reference to the specific risk factors and interventions associated with each outcome.

The Etiology of Sub-Optimal Birth Outcomes

This section discusses the causes of prematurity, low birthweight, and neonatal mortality. Specifically, the etiology of and risk factors associated with each sub-optimal birth outcome, and the interventions believed to reduce the incidence of the outcome, are presented.

Prematurity

Prematurity is a significant contributor to infant mortality in the United States (Meis, Ernest, Moore, Michielutte, Sharp, & Buescher, 1987). This relationship

occurs primarily through the positive and causal relationship of prematurity with low birth weight (Institute of Medicine, 1985). As the primary determinant of low weight births and neonatal mortality, the causes and potential prevention of preterm labor have been the focus of a sizeable body of research (e.g., Main, Gabbe, Richardson, & Strong, 1985; Papiernik, Bouyer, Dreyfus, Collins, Winisdorfter, Guegin, Leconte, & Lazar, 1985; Herron, Katz, & Creasy, 1982; Mahan, 1983; Johnson & Dubin, 1980).

The appropriate definition of 'premature' or 'preterm' birth has been the subject of academic debate in recent years. Many, including the World Health Organization, use prematurity to refer to infants born at between 20 and 37 weeks of gestation (Papiernik et al., 1985). Others argue that, because the calculation of gestational age is dependent upon a woman's recollection of her last day of menses (unless ultrasound has been used), this figure is not always accurate. They further point out that, since birth weight is intimately related to prematurity, a combination of birth weight and gestational age should be used (Kaltreider & Kohl, 1980).

From an epidemiological perspective, prematurity is often used to refer to a <u>preterm</u> low birth weight (P-LBW) or a <u>term</u> (i.e., age greater than 37 weeks) low birth weight (T-LBW) infant, rendering all low birth weight

infants as premature whether term or not (Kaltreider & Kohl, 1980, pp.17-18). This designation is important to the identification of epidemiological factors unique to preterm low birth weight infants as distinct from those factors, such as intrauterine growth retardation, that are responsible for low birth weight but not preterm birth. In addition, the finding that perinatal mortality (i.e., death to infants between 20 weeks gestation and 7 days of life) among preterm low birth weight infants is five times (287.8 per 1,000) that among term infants (60.4) suggests that this designation may be useful (Kaltreider & Kohl, 1980). At this stage of debate and analysis, however, gestational age alone is still the most commonly employed measure of prematurity in the United States.

<u>Risk factors associated with prematurity</u>

Maternal characteristics associated with prematurity include low socioeconomic status, repetitive prematurity, unwanted pregnancy, smoking, multiple pregnancies, abruptio placentae, placenta previa, and maternal illnesses (Fedrick & Anderson, 1976; Johnson & Dubin, 1980; Kaltreider & Kohl, 1980). Among these factors, low socioeconomic status contributes an estimated 60% of all preterm deliveries. For example, for indigent maternity patients the incidence of prematurity is two to three times the rate among patients seen by private physicians. The particular mechanisms through which socioeconomic standing operates on

prematurity are not identified in the literature (Hemminki & Starfield, 1978; Johnson & Dubin, 1980). Those variables that are expected to operate on prematurity are inadequate nutrition, poor living conditions and stress; but this area requires more study.

After socioeconomic status, previous preterm births and miscarriages are the most accurate predictors of preterm delivery (Johnson & Dubin, 1980). Women who have had a previous preterm birth or low birth weight infant are at the greatest risk of delivering a preterm, low birth weight infant, with a relative risk of 3.47 compared to women who have not have a previous low birth weight or premature infant (Ernest, Michielutte, Meis, Moore, & Sharp, 1988).

Race and age are also correlated with preterm births; nonwhite infants have a much lower mean gestational age than white infants, and infants of mothers less than 15 years of age have the highest rates of prematurity (Kaltreider & Kohl, 1980). Moreover, black and Puerto Rican women have prematurity rates twice as high as white women even after controlling for differences in income, education, and occupational differences. It has been suggested that genetic differences may be responsible for the unequal risk of preterm delivery among white and nonwhite women. However, research confirming this hypothesis is not yet available (Johnson & Dubin, 1980). Among teens (i.e., less than 19 years of age), it is

expected that biological immaturity is responsible for high rates of prematurity. Again, the causal relationships have not yet been scientifically documented.

In addition to these other risk factors, unmarried women, women who do not participate in prenatal care and those with low levels of education all have increased risks of premature births. Women who are unmarried have a 90% higher chance of having a preterm birth than married women (Kaltreider & Kohl, 1980). Those women who have obtained insufficient or no prenatal care are much more likely to have a preterm birth than women with adequate prenatal care. Finally, among women with 9-11 years of education, the risk of a preterm, low birth weight infant is 1.42 times that of women with 12 or more years of education (Ernest et al., 1988).

Although some of these risk factors are not amenable to direct intervention (i.e., previous preterm births or current multiple gestation), other characteristics such as teenage pregnancy, inadequate prenatal care and poor nutrition are the targets of clinical interventions and research. The interventions believed to play a role in the reduction of premature births are noted below.

<u>Interventions to Reduce the Risks of Prematurity</u>

The interventions believed to be most effective in the prevention of preterm birth include the reduction of unwanted pregnancies, the reduction of maternal health

risks, such as stress and smoking early in the pregnancy, and the provision of adequate prenatal care. The services aimed at these problems are numerous.

The most common method of reducing unwanted births, and that found to most effectively reduce the rates of prematurity, is the use of family planning services (Johnson & Dubin, 1980). For example, studies by Rovinsky (1973) and Taylor (1977) have reported significant reductions in prematurity following the availability of contraceptive services and sterilization to patients who desired these services. The risks of preterm birth presented by multiple gestation (i.e., twins) are believed to be reducible through the cautious use of fertility drugs, by delaying pregnancy until 3 months after discontinuation of oral contraceptives and with bed rest (Misenhimer & Kaltreider, 1978). Interventions employed or recommended when preterm risks are present in a pregnancy include the cessation of alcohol use, nutritional counseling, treatment and bed rest for plural pregnancies, and "political, education and social reform" for low socioeconomic status (Johnson & Dubin, 1980, p. 66).

In response to these risk factors and their amenability to interventions, a number of states have implemented programs aimed at reducing prematurity through the provision of prenatal care services, education and counseling for women identified as high risk. Many of

these efforts are based on the effectiveness of France's national program for the prevention of preterm birth and the subsequent evaluations of this program by Papiernik et al. (1985). These studies suggest that this program produced significant reductions in the prematurity rate in the region of France studied. Papiernik's research has shown that the early identification of women at social or medical risk of a preterm birth and the subsequent education of these women on the signs of preterm labor were effective in reducing sub-optimal birth outcomes.

In the United States, researchers at the University of California in San Francisco initiated a similar preterm birth prevention program which includes the use of a risk assessment instrument used to identify women at increased risk of preterm labor (Creasy, Gummer & Liggins, 1980; Goni & Creasy, 1986; Herron, Katz, & Creasy, 1982). A clinical study of the effectiveness of the prematurity prevention program indicates that a significant decrease in the incidence of preterm delivery was associated with the implementation of the program (Herron, Katz, & Creasy, 1982). The components of this program that have subsequently been carried to other states are the use of the risk assessment tool and the intensive education of women concerning the prevention of preterm labor.

Despite this research, it is estimated that two-thirds of prematurity comes from causes that are either not

understood or for which there are not effective interventions. The reduction of prematurity rates in the United States is therefore not expected to occur rapidly nor without interventions targeted specifically at increasing the socioeconomic status of many women (Main et al., 1985). As one physician puts it

> . . . low economic status and its associated problems of a lifetime of poor nutrition, poor hygiene, poor housing, and poor education are probably the causes for our high rate of prematurity in many areas of this country. These problems are social, not obstetric, but when they are solved, the prematurity rate will be reduced by one half to one third its present rate. (Dr. E. Stewart Taylor, p. 898 in Main et al., 1985).

The next section reviews the literature on the risks associated with and interventions aimed at the incidence of low birth weight.

Low Birth Weight

Low birth weight is a major determinant of adverse pregnancy outcomes (Starfield, 1985). An estimated two-thirds of all neonatal deaths can be attributed to low birth weight. Moreover, low birth weight infants have a risk of neonatal death forty times that of normal birth weight infants (Institute of Medicine, 1985). Moreover, the risk of neonatal mortality increases rapidly among lower birth weight infants (McCormick, 1985) even though the survival rates of these very low birth weight infants have improved dramatically due to advancements in neonatal

intensive care (McCormick, 1989). Despite the ability of neonatal intensive care to improve the survival of low birth weight infants, prevention of low birth weight births is still viewed as the best means of achieving reductions in the nation's rate of neonatal mortality (Institute of Medicine, 1985; McCormick, 1985).

Between 1965 and 1966 the percent of low birth weight infants in the U.S. reached a peak. Since this time it has declined only modestly. Between 1971 and 1981 the proportion of low-weight births declined only nine-tenths of one percent, from 7.6 to 6.7 percent of all live births (Institute of Medicine, 1985). These declines were found to be concentrated among infants weighing between 1,501 grams and 2,500 grams and among term as compared to preterm low birth weight infants. In fact, between 1970 and 1980 the proportion of preterm low birth weight infants among low birth weight infants increased (Hutchins, Kessel, & Placek, 1984). Moreover, a 1990 report from the Centers for Disease Control (CDC) indicates that the overall rate of low birth weight in the U.S. has increased in recent years.

The ability of public programs and of increased access to obstetrical care for poor women to reduce low birth weight is, therefore, an important empirical question. The research that addresses this issue and the primary causes of low birth weight are summarized below.

Risk Factors Associated with Low Birth Weight

The primary causes of low birth weight are inadequate fetal growth resulting from premature birth, poor fetal weight gain, or preterm rupture of membranes (Institute of Medicine, 1985). Other risk factors that operate to increase the probability of these conditions or otherwise predispose women to greater risks of low weight births can be grouped into the two general categories noted earlier (i.e., sociodemographic and medical factors) [with the addition of a third: behavioral/environmental factors (Institute of Medicine, 1985)].

Sociodemographic risk factors associated with low birth weight include low socioeconomic status, low levels of education, non-white race (particularly black) and marital status (Institute of Medicine, 1985). Childbearing at extreme ends of the reproductive age span (i.e., under 18 years or over 34 years of age) is also cited as a maternal risk characteristic (McCormick, 1985). Recent research, however, indicates that this factor may serve as a proxy for underlying population and environmental heterogeneity, such as poverty and social isolation (Geronimus, 1987). Moreover, it is argued that biological age is not as significant a factor in causing low birth weight among teenage mothers as are certain environmental, social and medical factors such as poor nutrition, inadequate social support, and lack of prenatal care (Geronimus, 1987). In

addition, maternal background characteristics associated with teenage childbearing and poor birth outcomes, such as nonwhite race, are regarded as 'proximate variables' that describe 'childbearing contexts' related to socioeconomic status rather than inherent biological risks (Geronimus, 1986, p. 1417). Because these variables are interrelated it is necessary to control for their impact when assessing the relative contribution of specific characteristics to birth weight.

Medical risk factors correlated with low birth weight births include poor nutritional status, poor weight gain during pregnancy, infection, toxemia, short interpregnancy intervals, and lack of medical care (Institute of Medicine, 1985; Picone, Allen, Olsen, & Ferris, 1982). Low birth weight risk characteristics categorized as behavioral/environmental include smoking, alcohol and other substance abuse, and exposure to toxic substances (Geronimus, 1987; Robert Wood Johnson Foundation, 1986; Institute of Medicine, 1985).

Overall, the influence of poverty and associated problems of poor nutrition, poor housing and sanitation, and lack of adequate medical care, are found to be the major determinants of the excessive rates of low birth weight and neonatal mortality among the nonwhite population (Gortmaker, 1979a; Institute of Medicine, 1985; Robert Wood Johnson, 1986). Significantly higher rates of low birth

weight are found in areas characterized as rural, nonwhite and poor, and those lacking in adequate health care facilities. Therefore, it is believed that much of the excess in the low birth weight rate could be eliminated by improving detrimental socioeconomic conditions such as poverty, lack of education, and poor nutrition. Interventions regarded as important to the reductions of low birth weight are summarized below.

Interventions to Reduce the Risks of Low Birth Weight

Numerous approaches, both medical and social, have been introduced as potential means of reducing low birth weight. Of primacy is the education of women concerning health and reproduction prior to conception. This education is believed to reduce the incidence of unwanted births and maternal risks associated with unhealthy behaviors. After conception, the identification of women at risk of a low weight birth and the education of these women concerning the management and reduction of risks is another method of reducing low birth weight (Institute of Medicine, 1985). This intervention is usually implemented through the provision of prenatal care -- the most commonly recommended intervention to reduce the risks of low birth weight. The evidence suggests that adequate prenatal care reduces low birth weight, especially among high risk women (Gortmaker, 1979a). For example, one study of pregnant women in New York City reports that the frequency of low

birth weight among women at sociodemographic risk who had received inadequate prenatal care was twice that of women who received adequate care (Kessner, 1973). Moreover, those who were not at risk but who had inadequate care had 1.8 times the rate of low birth weight infants as women with adequate prenatal care (Kessner, 1973).

These findings have been supported by the work of Shah & Abbey (1971), Levy, Wilkinson, & Marine (1971), Donaldson & Billy (1984), Greenberg (1983), Scholl, Miller, Salmon, Cofsky, & Shearer (1987), and others. For these reasons, most health planners believe that prenatal care should be provided to all pregnant women in need (Institute of Medicine, 1988). In response, it should be noted that despite the various risk factors associated with low birth weight, the most common intervention aimed at reducing low birth weight is prenatal care services. A quote from the Institute of Medicine comments most succinctly on this fact,

> No single approach will solve the low birth weight problem. Instead, several types of programs should be undertaken simultaneously. These range from specific medical procedures to broad scale public health and educational efforts. (Institute of Medicine, 1985, pp. 3-4).

Neonatal Mortality

Neonatal mortality refers to that part of infant mortality that includes deaths to infants in the first 28 days of life. In 1986, an average of 6.7 infants per 1000

live births died within this first month of life in the U.S. This number represents approximately 75 percent of all infant deaths. Neonatal mortality is highly related to biological and medical causes, such as low birth weight, congenital anomalies, maternal complications of pregnancy, and other infant diseases. Post-neonatal mortality is more strongly associated with environmental and other non-biological conditions (Institute of Medicine, 1985).

Risk Factors Associated with Neonatal Mortality

A host of characteristics have been identified as increasing the risk of neonatal mortality. These include such sociodemographic and medical characteristics as black race, young maternal age, low education, single marital status, parity of one, and inadequate prenatal care (Eisner, Brazie, Pratt, & Hexner, 1979; Institute of Medicine, 1985). Entry into prenatal care in the last trimester (i.e., after 24 weeks of pregnancy) or multiple births (i.e., twins) are the primary medical factors associated with higher incidence of low birth weight (Institute of Medicine, 1988).

Race. The most predominant individual risk factor, and that least amenable to intervention for a pregnant woman is non-white race. Black women experience twice the rate of infant mortality and low birth weight of white women in the United States (Institute of Medicine, 1985). The reasons for this differential are not well understood, except

through the correlation of race with other risk factors such as poverty and reduced access to prenatal care (Institute of Medicine, 1987). However, in a study of the causes of high rates of neonatal mortality among black infants, the increased incidence of low birth weight among this population was found to be the major contributor to these increased rates (Binkin, Williams, Hogue, & Chen, 1985).

A recent study also points to events prior to conception, such as poor maternal childhood nutrition and low socioeconomic status, which are found to negatively affect physical stature and nutritional status in the adult years, thus rendering a woman at increased risk of a poor birth outcome (Emanuel, Hale, & Berg, 1989). In effect, the literature implies that the long term disadvantage that the black population has experienced has created poorer overall health in multiple generations of women, thereby causing higher rates of low birth weight and neonatal mortality among all black infants. This line of research is young, however, hence the influence of black race on neonatal mortality is not well understood. The fact that the black infant mortality and low birth weight rates have remained at twice the white rates throughout the 20th century, however, indicates that important racial differences are in operation. For these reasons, all of

the analyses in this study are race-specific, focusing on white and black births only.

Age. Maternal age is another significant predictor of neonatal mortality. Teenage mothers and those aged 35 or older have higher rates of low birth weight than mothers in their twenties or early thirties (Institute of Medicine, 1985). However, young age is highly correlated with other factors, such as low socioeconomic status, marital status and education. Geronimus (1986), for example, argues that it is not teenage childbearing per se that causes high rates of neonatal mortality, but the correlation of teenage childbearing with other sociodemographic risk factors. Teenage childbearing is viewed as a proxy for other maternal risk factors rather than a measure of extreme biological risk.

Nevertheless, pregnant women at extreme ends of the childbearing cycle have increased probabilities of low birth weight and neonatal mortality. McCormick, Shapiro, & Starfield (1984) have found the rates of neonatal mortality among infants of teenage mothers (aged 19 or less) to be more than one and a half times higher than among mothers between 20 and 35 years of age. Babson & Clarke (1983) concur with this finding, reporting rates of neonatal mortality at 7.2 among women between 30 and 34, and rates of 10.0 for women less than 20. The majority of the differential in neonatal mortality risk by age is believed

to be due to the lower average birth weights of infants of teenagers. While birth weight-specific mortality is similar across age groups, the higher rates of low birth weight and very low birth weight (i.e., birth weight less than 1500 grams or approximately 3 pounds) among infants born to teenagers account for the majority of the increased rates of neonatal mortality (Babson & Clarke, 1983).

Education. Low maternal education is another individual sociodemographic characteristic that places infants born to such women at increased risk of neonatal mortality. Low education is an indicator of increased risk of both infant mortality and low birth weight (Cramer, 1987). It presumably operates through a reduced understanding, both of proper health behaviors and of the need for prenatal care, and through its correlation with low socioeconomic status. Moreover, a recent report by the Institute of Medicine (1985) indicates that the gap in rates of low birth weight among mothers with and without high school diplomas has increased in the past 10 to 15 years.

Marital Status. Marital status operates in a manner similar to age and education, by increasing a woman's risk of having an infant death both independently and in conjunction with these factors (Cramer, 1987). In a study of infant deaths in Georgia, for example, unmarried women are reported to have twice the rate of neonatal mortality

of married women (i.e., 20 compared to 10 deaths per 1000 live births)(McCarthy, Shultz, & Terry, 1982).

Community structural variables, or those variables that describe the community context and the social influences constraining an individual or group's behavior, can also be grouped into sociodeomographic and medical categories. Sociodemographic forces are key because of the linkage of neonatal mortality with community level rates of poverty and access to medical care. Over and above the effects of individual poverty, aggregate poverty levels are repeatedly found to increase the risk of infant mortality (Stockwell, Wicks, & Adamchak, 1978; Gortmaker, 1979; Brooks, 1980; Miller & Stokes, 1985). In particular, community poverty increases post-neonatal mortality more significantly than it does neonatal mortality due to increased environmental exposure of the infant to disease or accident over time. A study of rates of post-neonatal mortality among the poor in Kentucky shows that, compared to the non-poor, most of the post-neonatal deaths were attributable to a higher incidence of infection and sudden infant death syndrome (Spurlock, Hinds, Skaggs, & Hernandez, 1987).

Because of its relationship with family poverty status, enrollment in the Aid to Families with Dependent Children (AFDC) program is also associated with higher incidence of low birth weight and infant mortality (Spurlock et al, 1987). Given the individual effects of race, age,

education, and marital status on infant mortality, the rates of these characteristics at the community level are expected to influence rates of birth outcomes in the aggregate.

Interventions to Reduce the Risks of Neonatal Mortality

Evidence exists to suggest that adequate prenatal care, pregnancy education, and social support can reduce the risks of infant mortality among disadvantaged populations (Institute of Medicine, 1988). Specifically, the medical interventions believed to decrease the risk of infant mortality or low birth weight include the availability and utilization of obstetrical services, prenatal care, neonatal intensive care and abortion services.

All of these medical factors, with the exception of abortion services, operate in the same direction to reduce the probability of infant death by improving maternal and infant health or by reducing obstetrical risks through medical care. Neonatal intensive care services improve the survival probabilities of low birth weight, premature or otherwise compromised infants. Abortion services, on the other hand, affect birth outcomes by reducing the number of unwanted births. For example, it is reported that increases in the abortion rate across U.S. counties were responsible for the major portion of the reductions in neonatal mortality (Grossman & Jacobowitz, 1981). Thus, it seems that medical interventions may help to overcome many

sociodemographic and medical risk factors in the population.

Summary

This chapter reviewed the literature on the etiology of and risk factors associated with prematurity, low birth weight and neonatal mortality, as well as the social and medical interventions expected to reduce the risks of these outcomes. The intent of this chapter was to provide insight into the multi-dimensional nature of the causes of poor birth outcomes, as well to provide an overview of the programs aimed at reducing the incidence of these outcomes.

It should be clear from this review that the sociodemographic and medical factors that are associated with increased risk of prematurity and low birth weight are much the same as those associated with neonatal mortality. Consequently, interventions designed to reduce the incidence of these sub-optimal birth outcomes, such as prenatal care and health education, have significant overlap.

Considering the complexity of maternal and infant health and the outreach of the programs described, it should also be clear that the measurement of the simultaneous effects of maternal and county characteristics and public interventions is critical to sound program evaluation. Moreover, because many of the public programs are administratively coterminous, such as Medicaid and AFDC

which have shared eligibility and enrollment requirements, it is especially critical to consider their simultaneous effects. This study addresses such issues by evaluating the IPO, using multiple methods and by controlling for as many relevant variables as possible given available data.

In the next chapter the organization and implementation of the IPO program nationally and in Florida are described in detail. Because statewide public programs are known to vary at the local level in their implementation and services, this detailed presentation of the program (e.g., the number of participants and expenditures per county) is critical to an evaluation of the IPO's effectiveness.

CHAPTER THREE
THE IMPROVED PREGNANCY OUTCOME PROGRAM

This chapter describes the organization and administration of the IPO program both nationally and in Florida. This information is necessary to achieve an undertanding of how the IPO theoretically operates to influence birth outcomes. After discussing the federal implementation of the IPO demonstration programs, the provision of IPO services, their outreach, and costs in Florida are described.

The National Improved Pregnancy Outcome Program

One of the most direct and comprehensive efforts to expand the provision of prenatal care to low income pregnant women in the U.S. was created through legislation that established the Improved Pregnancy Outcome (IPO) Program. The IPO program was initiated as part of the Child Health Strategy formulated by the Bureau of Child Health Services in 1976 to develop "state-based systems of care for mothers and children" and to provide funds to states with high rates of infant mortality in order to improve maternal care and pregnancy outcomes (Strobino, 1985, p. 542). In particular, the intent of the IPO was to encourage the organizational capacity of states to develop or upgrade their systems of perinatal care.

The IPO program was also created to provide services to financially indigent pregnant women. In most states, the IPO eligibility criteria was set at 100% of the federal poverty line. The overall services that were to be delivered to eligible pregnant women at each demonstration site included comprehensive outpatient prenatal care, some arrangements for delivery, and postpartum care.

Initially 13 states were awarded IPO grants. By 1980, however, 34 states had operational IPO projects. Grants were awarded for five year periods, with direct Federal involvement terminated after this time. To facilitate state-specific modes of service delivery, states were allowed considerable flexibility in implementing their IPO services. 'Organizational alternatives' were, however, suggested, and the evaluation of these demonstration programs was deemed an important part of the federal IPO efforts (Peoples, Grimson, & Daughtry, 1984).

With the goal of systematically evaluating the federal IPO efforts, a research firm was hired in 1977 to develop a set of evaluation tools appropriate for the IPO program. These evaluation tools took the form of surveys and other data collection instruments, and were field tested in five states during the second year of program. The results of these field tests showed that the IPO program was improving systems of perinatal care delivery in these states, but the findings concerning the impact of the program on birth

outcomes were inconsistent (Peoples, Grimson, & Daughtry, 1984).

A subsequent evaluation of the program conducted in 1980 and 1981 by Westinghouse showed that most states had not been successful in carrying out program evaluations. Moreover, this study noted that, as a result of inadequate evaluations, little information about how to modify the program or evaluate its effectiveness. Thirteen years after the implementation of the IPO, the availiabilty of data on the efficacy of the IPO is still minimal.

This research is an effort to provide information on the effectiveness of Florida's IPO program. The remainder of this chapter is a description of the Florida IPO program, including discussions of the structure, size and limitations of the program.

Florida's IPO Program

In 1976, because of its higher than average rates of infant mortality, Florida was selected as one of the initital states to receive IPO funding. These funds were directed at five contiguous counties in south Florida that had especially poor rates of birth outcomes. These counties were Lee, Hendry, Glades, Hardee, and DeSoto. Between October 1, 1980, and September 30, 1981, additional federal funds were provided to establish IPO demonstration projects in three more counties: Lake, Marion and Putnam.

In 1982, when the Federal IPO funds were scheduled to terminate, the Florida Legislature approved general revenue funding for the continuation and expansion of IPO services in the state. By January, 1983, all HRS health planning districts (i.e., the 11 groups of contiguous counties that contsitute the districts through which state health planning is administered), had operational IPO programs. By 1984, 65 of the state's 67 counties had operational programs. The last two counties implemented services in 1985. Since this time, IPO projects in every county have been in continuous operation.

Currently, the stated purpose of the IPO program in Florida is,

> the development of health programs throughout the state which improve the health of mothers and children, improve the outcome of pregnancy of mothers and children, and improve the health of newborns, infants, preschool, and school age children, adolescents and young adults. The mission is to identify, organize, and coordinate all available resources to develop intervention programs which will ultimately result in the prevention of morbidity and mortality in mothers and children. (DHRS, 1987, p. 1).

Most IPO care is delivered through county public health units, community health or migrant health centers. The basic components of the IPO program include: basic prenatal care provided by nurses physicians or midwives, nutritional and parenting education, home visits, some delivery arrangements, well-baby care, family planning, WIC and immunization services. In addition to these services,

Florida's IPO program includes services that are offered through the 'Preterm Birth Prevention' (PTBP) component. Added in 1984, in response to the increasing numbers of low birth weight infants, this component is aimed at reducing the incidence of low birth weight by diminishing the risks of preterm labor among medically indigent pregnant women. It is believed that, through the provision of comprehensive prenatal care services to women at high risk of preterm delivery, rates of sub-optimal birth outcomes will decline. This preterm birth prevention program is one of the few statewide services of its kind.

The next section describes both the basic services provided to all IPO participants and the special care delivered to at-risk women through the preterm birth prevention component of the IPO. Following this discussion, the details of IPO program outreach and expenditures are presented.

Services Provided by the IPO

Although some flexibility in the implementation of the IPO program is allowed, the services that must be delivered at every site in Florida include

a) Outreach and marketing to reach the target population;

b) Information, education, and counseling to pregnant women;

c) Early and continuous prenatal care, including an initial and complete history and physical;

d) Risk assessment, treatment or referral of complications and minor illnesses;

e) Preterm labor prevention, including screening, education, and specific assessments and referral;

f) Home visits for the higher risk client for individual and family assessment, education and counseling;

g) Routine laboratory services;

h) Coordination and linkage to other CPHU and community programs, such as WIC, Children's Medical Services, Primary Care, Family Planning, Well Infant Care, private providers, delivery resources (hospital or birth center), and many others;

i) Referral and follow-up procedures to assure that appropriate care is obtained;

j) Advocacy for improved services to pregnant, postpartum and lactating women and teenagers.

The means by which these services are implemented and the number and type of services provided varies across counties and according to the resources available in each county. Many counties, for example, have nursing shortages that make it impossible to provide home visits to all IPO participants; and in larg counties with high services demands, waiting lists of 4-6 weeks for an initial appointment are not uncommon. These differences in resource supply and service demand across counties render the impact of the IPO on birth outcomes inherently variable. The nature of this variation, however, is not easily assessed. For example, some urban counties reduce their waiting lists by providing group rather than

individual nutrition education sessions, or they schedule fewer prenatal visits for low risk women.

IPO Procedures. In general, each county IPO program in Florida provides basic prenatal care services to all participants. To become enrolled a woman must have a pregnancy test at the IPO site and test positive. If the woman is pregnant, she is given an appointment, usually within one week, to return to have a medical history and clinical assessment completed. This procedure includes an examination by a doctor or nurse, blood work, and nutritional and preterm labor risk assessments. In addition, a nurse usually gathers psychosocial information at this time and provides education concerning pregnancy and good nutrition.

Program Enrollment. During the first visit, the participant must also complete requisite forms concerning her income status. If she is believed to be eligible for Medicaid or AFDC, she will also be directed to these programs. In all counties, IPO women are nutritionally tested and enrolled in WIC if they are determined to be eligible (i.e., nutritionally deficit). In many counties, economic service workers (i.e., those who determine Medicaid and AFDC eligility) are located in the health department. In these counties, Medicaid program enrollment is typically higher than average, and the time between

application and eligibility determination is shorter. Many state health workers believe thist the co-location of economic services staff improves participation in the IPO and other programs. As a result, birth outcomes in these counties are expected to be better because of this improved enrollment.

After the first visit, subsequent appointments are scheduled based on the stage of the woman's pregnancy. The timing of prenatal visits provided to each IPO woman is set by state protocol and is based on standard obstetrical practices. If a woman is assessed as at high risk for a pre-term birth, she recieves more frequent visits and more invasive treatments (i.e., weekly cervical checks).

Delivery Services. Because the IPO program was developed to provide outpatient prenatal care only, the costs of delivery for IPO participants are not paid for by the program. IPO women must make their own arrangements for delivery. Most counties, however, assist women in establishing contact with the hospital in which they will deliver, and also have arrangements for sending their medical charts to the hospital prior to delivery. IPO women who are enrolled in Medicaid have their delivery paid for by Medicaid.

Postnatal Care. After delivery, IPO participants are either visited in the hospital by an IPO nurse who provides family planning information, or is given an appointment to

return to the clinic for a family planning visit as well as for a 'well-baby' visit. These services are aimed at preventing unwanted pregnancies and keeping the newborn healthy with periodic visits.

Preterm birth prevention services

Implementation of the PTBP component is administered through the IPO at county health departments and community health centers. In the fall of 1983, more than 1,500 health professionals across the state were trained during two days of intensive in-service education to implement the Florida PTBP protocol. Monitoring of program implementation and cost accounting is conducted by a central office. Fully implemented in 1985, the stated goal of the PTBP was to reduce the rate of low weight births in Florida from 7.4% to 3.9% by 1989. Additionally, the State set a goal of reducing the infant mortality rate to 9.9 by the end of 1989. Neither of these goals were met.

Through the PTBP program service, each IPO woman is assessed for the risk of preterm birth during her first prenatal visit and again at 26-28 weeks of gestation. This assessment is done using a risk scoring system developed by Robert Creasy based on the work of Papiernik et al. (1985) in France. Florida's risk assessment instrument is called the 'Preterm Delivery Risk Scoring Form'. On this form, data concerning a women's socioeconomic status, age, education, lifestyle and medical risk characteristics

(e.g., uterine anomaly or a second trimester abortion) are recorded. For each risk characteristic noted one point is awarded. Women with scores of ten or more are considered at high-risk for a preterm birth and are given special care under the preterm birth prevention protocol.

For women assessed as 'high-risk', the treatment protocol includes weekly visits and a cervical check. All patients receive special counselling and education related to preterm labor signs, as well as education concerning good nutrition habits and methods of coping with stress. These women are also encouraged to establish open communication with the nurse clinician, and are offered psychological support from members of a parent support group (Mahan, 1983). Women assessed as low risk are provided standard maternity care through the same program.

These features constitute a comprehensive program of maternity care for financially eligible pregnant women in Florida. Moreover, the IPO program is often a point of entry into other social programs such as Medicaid, WIC or family planning services.

IPO Women served

Table 3-1 presents the number of IPO participants in each county for each year between 1984 and 1988. The variability in program size is evident in this table, as is the trend of increasing enrollment over time. Factors influencing program size (i.e., numbers of clients seen)

Table 3-1: Number of IPO Participants in Each County in Florida, 1984-1988

County	HRS District	84-85	85-86	86-87	87-88	88-89
Escambia	1	213	219	286	668	844
Okaloosa	1	136	269	330	534	597
Santa Rosa	1	65	76	122	193	358
Walton	1	37	73	127	219	276
Bay	2	378	503	507	666	591
Calhoun	2	13	52	31	86	92
Franklin	2	8	25	5	35	27
Gadsden	2	90	105	153	359	440
Gulf	2	11	20	20	47	41
Holmes	2	18	80	137	129	135
Jackson	2	124	185	176	153	243
Jefferson	2	98	40	50	54	65
Leon	2	210	430	636	752	837
Liberty	2	6	4	0	13	17
Madison	2	20	96	117	141	143
Taylor	2	0	65	96	79	96
Wakulla	2	24	33	54	82	100
Washington	2	13	36	39	104	65
Alachua	3	925	731	730	685	1004
Bradford	3	66	120	152	134	159
Citrus	3	135	164	223	311	380
Columbia	3	133	91	207	287	337
Dixie	3	85	138	119	117	133
Gilchrist	3	55	79	65	65	86
Hamilton	3	3	12	21	36	29
Hernando	3	38	87	116	108	118
Lafayette	3	18	31	38	36	47
Lake	3	691	703	775	819	793
Levy	3	119	194	195	192	278
Marion	3	793	789	902	1008	1006
Putnam	3	562	699	515	659	331
Sumter	3	155	150	170	241	285
Suwannee	3	113	101	119	171	193
Union	3	41	42	51	46	57
Baker	4	58	83	57	117	133
Clay	4	131	132	113	208	281
Duval	4	2926	2510	2735	2527	3202
Flagler	4	50	56	54	83	108
Nassau	4	33	168	160	308	207
St Johns	4	182	214	265	381	380
Volusia	4	1040	1313	1313	1293	1336
Pasco	5	559	648	603	608	778
Pinellas	5	2032	2539	2632	2342	2663
Hardee	6	178	233	344	372	436
Highlands	6	183	331	329	276	443
Hillsborough	6	2264	4438	4518	4997	4891

Table 3-1--Continued: Number of IPO Participants in Each County in Florida, 1984-1988

County	HRS District	84-85	85-86	86-87	87-88	88-89
Manatee	6	171	751	831	891	817
Polk	6	1827	2408	2474	2656	2918
Brevard	7	342	974	1105	1543	1652
Orange	7	1315	1401	1776	2193	2777
Osceola	7	173	269	253	387	466
Seminole	7	341	448	545	781	918
Charlotte	8	39	101	112	210	265
Collier	8	200	611	712	897	1102
DeSoto	8	78	93	99	73	100
Glades	8	42	19	29	33	45
Hendry	8	77	164	147	207	360
Lee	8	954	1000	985	1144	1516
Sarasota	8	288	436	521	632	807
Indian River	9	168	229	363	536	539
Martin	9	246	356	453	667	619
Okechobee	9	63	131	271	261	214
Palm Beach	9	1756	1784	2293	3566	3794
St Lucie	9	13	190	556	771	393
Broward	10	3144	3518	3526	3838	4458
Dade	11	3296	3591	3846	4117	4468
Monroe	11	151	126	147	208	216

Source: HRS State Health Office, Data Analysis Section.

include: (1) the projected number of women in need (based on the State's estimate of this population); (2) demand; (3) the amount of county funding of the program; (4) the county resources available (including personnel and physical space); and (5) state revenue allocated to the program.

Between September 30, 1988, and October 1, 1989 (i.e., Florida's contract year), a total of 54,322 IPO clients were seen and over 964,000 IPO services (i.e., a prenatal visit) were provided in Florida. This averages to approximately 17 visits for every IPO client. The county reporting the fewest IPO participants was Liberty county with a total of 19 clients. Hillsborough county served the largest number of women, reporting 4,423 clients during this year. Compared to the 1984-1985 program year when just less than 30,000 women were served, the number of women served in 1988-1989 represents an increase in participation rates of over 54% The IPO program now delivers prenatal care to over 30% of all women having births in Florida.

Program Expenditures

Funding of the IPO is provided by a combination of federal, state and county funds, including reimbursements for services from Medicaid. Table 3-2 is a summary of the state, county and total expenditures on the IPO program in each county during 1988-1989. This table also includes

Table 3-2: Summary of County Staff, Participants, Services and Expenditures for the IPO Program, 1988-1989 Fiscal Year

DISTRICT	CTY. NUMBER	COUNTY	FTE's	CLIENTS	SERVICES	STATE EXPEND.	COUNTY EXPEND.	TOTAL EXPEND.
3	1	Alachua	19.13	1,383	21,812	408,428	137,690	546,118
4	2	Baker	2.00	154	2,872	83,769	9,442	93,211
2	3	Bay	11.58	800	8,541	277,573	74,489	352,062
3	4	Bradford	2.05	216	3,411	77,973	10,632	88,605
7	5	Brevard	29.55	1,635	35,911	1,440,295	4,556	1,444,852
10	6	Broward	77.43	4,608	100,475	1,977,188	659,060	2,636,248
2	7	Calhoun	1.59	87	1,895	58,723	7,687	66,410
8	8	Charlotte	3.25	338	3,345	304,005	21,399	325,404
3	9	Citrus	5.20	340	4,673	126,452	69,999	196,451
4	10	Clay	3.80	394	5,597	146,117	0	146,117
8	11	Collier	16.34	618	13,737	453,321	185,301	638,622
3	12	Columbia	4.90	331	7,668	180,738	29,339	210,078
11	13	Dade	83.69	4,012	106,268	2,859,353	254,730	3,114,082
8	14	Desoto	1.97	103	1,614	74,824	756	75,580
3	15	Dixie	1.64	125	3,007	45,777	5,266	51,043
4	16	Duval	22.44	2,364	28,704	881,838	199,997	1,081,835
1	17	Escambia	6.41	922	5,110	285,211	0	285,211
4	18	Flagler	1.99	137	2,881	42,798	24,041	66,839
2	19	Franklin	0.33	19	167	11,335	0	11,335
2	20	Gadsden	13.21	553	12,057	430,066	31,071	461,137
3	21	Gilchrist	1.71	93	1,149	78,573	7,811	86,385
8	22	Glades	0.51	32	463	12,574	6,042	18,616
2	23	Gulf	0.54	58	470	18,242	3,218	21,460
3	24	Hamilton	0.13	43	121	6,999	4,748	11,747
6	25	Hardee	6.59	419	7,647	152,912	32,755	185,666
8	26	Hendry	3.60	310	3,394	93,884	29,846	123,730
3	27	Hernando	1.88	185	2,095	16,167	53,617	69,784
6	28	Highlands	9.38	443	9,742	224,308	74,608	298,916
6	29	Hillsborough	75.73	4,423	64,197	1,702,589	777,570	2,480,159
2	30	Holmes	1.30	147	852	34,288	2,576	36,864
9	31	Indian River	8.45	380	7,877	327,017	79,946	406,963
2	32	Jackson	3.35	208	4,408	168,551	53,612	222,163
2	33	Jefferson	0.18	73	1,050	7,781	324	8,105
3	34	Lafayette	0.77	54	1,042	26,381	3,420	29,801
3	35	Lake	10.88	796	18,173	295,945	85,495	381,439
8	36	Lee	25.43	1,980	34,981	829,981	459,584	1,289,565
2	37	Leon	8.02	832	8,703	302,081	32,896	334,977
3	38	Levy	2.85	270	4,298	69,109	11,535	80,644
2	39	Liberty	0.26	19	112	8,152	915	9,066
2	40	Madison	0.91	111	2,070	40,559	907	41,466
6	41	Manatee	4.76	929	4,364	167,545	105,966	273,511
3	42	Marion	15.70	1,088	19,892	573,060	128,068	701,128
9	43	Martin	8.34	543	13,942	238,593	91,582	330,175
11	44	Monroe	5.70	254	3,050	338,817	52,517	391,334
4	45	Nassau	5.24	351	7,615	181,227	41,999	223,226
1	46	Okaloosa	8.56	650	5,903	213,913	0	213,913
9	47	Okeechobee	0.00	286	286	58,041	0	58,041
7	48	Orange	55.42	2,401	50,502	2,083,272	730,055	2,813,327
7	49	Osceola	10.37	552	10,745	421,216	79,373	500,589

SOURCE: HRS CLIENT INFORMATION SYSTEM - HEALTH MAINTENANCE COMPONENT

PREPARED BY: HRS STATE HEALTH OFFICE, DATA ANALYSIS SECTION 05-FEB-90

Table 3-2--Continued

DISTRICT	CTY. NUMBER	COUNTY	FTE's	CLIENTS	SERVICES	STATE EXPEND.	COUNTY EXPEND.	TOTAL EXPEND.
9	50	Palm Beach	46.32	4,017	59,031	1,858,270	997,606	2,855,876
5	51	Pasco	6.67	354	7,147	155,150	40,371	195,521
5	52	Pinellas	61.29	3,024	56,601	2,011,660	219,266	2,230,926
6	53	Polk	35.46	2,899	45,277	980,431	50,087	1,030,518
3	54	Putnam	6.98	545	16,326	243,015	62,750	305,765
4	55	St. Johns	6.36	471	11,441	200,241	101,632	301,873
9	56	St. Lucie	7.37	433	9,186	226,189	42,942	269,131
1	57	Santa Rosa	2.17	246	1,432	69,567	5,539	75,106
8	58	Sarasota	26.97	823	24,201	785,661	528,299	1,313,961
7	59	Seminole	12.56	1,311	18,863	788,341	255,785	1,044,126
3	60	Sumter	5.07	260	5,596	164,131	10,355	174,487
3	61	Suwannee	3.29	241	5,176	94,375	12,776	107,151
2	62	Taylor	0.68	118	2,261	36,311	679	36,990
3	63	Union	0.97	77	940	35,022	2,227	37,248
4	64	Volusia	25.17	1,877	36,674	512,298	204,702	717,000
2	65	Wakulla	0.81	89	2,182	37,007	3,399	40,406
1	66	Walton	2.66	404	2,594	71,193	10,999	82,193
2	67	Washington	0.72	64	1,047	25,370	0	25,370
		TOTAL	836.58	54,322	964,863	27,151,789	7,225,857	34,377,646

SOURCE: HRS CLIENT INFORMATION SYSTEM - HEALTH MAINTENANCE COMPONENT

PREPARED BY: HRS STATE HEALTH OFFICE, DATA ANALYSIS SECTION 05-FEB-90

the number of full-time equivalent employees (FTE's), the number of clients seen, and the number of services provided in each county during this period. Between September 30, 1988, and October 1, 1989, total state expenditures on the IPO program were $27,151,789. County IPO expenditures during this 1988-89 period were $7,225,857, for a total of state and county expenditure over $34 million.

As with the number of participants served, county-level expenditures on the IPO vary dramatically. The total amount of funding across the state ranges between $8,105 per year (in Jefferson county) to $311,082 per year (in Dade county). Examined by source of funds, the range of state contributed expenditures runs from $6,999 in Hamilton county to $2,859,353 in Dade county. County funding ranges from $0 in Washington county to $997,606 in Palm Beach county. Variations in the amount of county expenditures is dependent on such factors as the County Commission's interest in the IPO program and the county's budget. The next section briefly reviews the evaluation of Florida's IPO program.

Effects of the IPO Program on Birth Outcomes

A review of state and national evaluations of the IPO program indicates variable impacts of the program (Meis et al., 1987; Peoples et al, 1984). In 1985 an evaluation of the impact of the IPO program in Florida was conducted by

the State Office of Evaluation and Management Review. This was the first comprehensive assessment of the IPO program and was undertaken as part of the statutory requirement that ten percent of HRS's programs be evaluated annually. The evaluation reported that the IPO program was successful overall, and that the services provided filled a critical need for maternity care among members of the target group. It was also concluded that the quality of services provided was good. Moreover, the report said that the Florida IPO program,

> is perceived as being at least moderately effective in preventing low birth weight births and neonatal deaths. Provision of services was documented to reduce overall incidence of low birth weight babies in 16 of the counties during the first year of service. Projects with a documented impact in the first year tended to provide more services per patient. (Office of Evaluation and Management Review, 1985, p.iii).

The primary methods of analysis used in this study were interviews with key informants and time series analysis. Much of the information concerning the implementation and impact of the program was based on subjective reports of informants; a source typically biased in support of the program under study. The time series analysis provided a more objective assessment of the program's impact on low birth weight before and after the implementation of the project, but these findings have yet to be replicated. The conclusions that the IPO was responsible for reductions in low birth weight and neonatal mortality in 16 counties,

therefore, is questionable without further analysis. This study is an attempt to more fully evaluate the effective of the program.

Summary

The intention of this chapter was to describe the background of the national IPO program and the operation of Florida's IPO program. In general, the IPO program is believed to provide comprehensive prenatal care services to enrolled women. The quality and amount of prenatal care provided, however, has not been measured. It is also noted that the size and funding of the IPO program across the state varies dramatically depending on the county's resources. In many ways, these variations render the IPO program a series of 67 programs rather than one statewide, homogenous public program. However, because the basic services to be provided to enrollees are the same in every county, the effects of the IPO program at the state level can still be established.

In the next chapter, the data set created for this analysis, the variables selected as measures of key independent variables, and the analytic techniques employed to address the questions posed are discussed. In addition, quantitative descriptions of the variables measured and a discussion of key methodological issues related to the analysis undertaken are presented.

CHAPTER FOUR
DATA AND METHODS

In this chapter, the methods used to evaluate the impact of the IPO on sub-optimal birth outcomes, the rationale for their use, and the data collected and manipulated for these analyses are discussed. Before this section, however, a number of data and methodological issues critical to the design of evaluation research are reviewed.

Issues in Program Evaluation

To measure the impact of the IPO program on birth outcomes a number of data and methodological issues were taken into consideration in defining this study. While important to research design in general, the concerns addressed here are those of particular relevance to program evaluation. Specifically, these concerns refer to issues surrounding the modeling of causal relationships and production of policy-relevant findings. Each issue is discussed below.

A primary concern in the collection of program evaluation data is the need to identify and measure information relevant to the goals of the program (Hatry, Winnie, & Fisk, 1981). This issue requires that 'official'

rather than 'perceived' objectives of the program be identified (Wholey, 1983). If the official goals are not the ones selected for analysis, results are typically of little relevance to program officials. In the present study measures of the individual and county occurrence of prematurity, low birth weight and neonatal mortality are used. These indicators are used because they are the outcomes identified by IPO program documents and officials as being targets of the IPO's efforts.

A second consideration in program evaluation is the need to identify the target population at which the intervention under study is aimed (Hatry, Winnie, & Fisk, 1981). The population eligible for the IPO's services are pregnant women with incomes less than 100% of the official federal poverty line. While information on women actually enrolled in the IPO are available, recent figures on the number of pregnant women or women of childbearing age living below poverty are not published. The most recent figures available are from the 1980 U.S. Census. Because of fluctuations in the U.S. economy, including increases in the poverty rate in the past decade, however, these 1980 figures were not used to calculated estimates of the population 'eligible' for IPO services. Instead, IPO program data describing the population enrolled in the program are utilized. In addition, the number of households with less than $10,000 in income and the number

of women of childbearing age are included in the county structural analysis as controls for shifts in these measures.

The third evaluation research issue addressed in this study was with the identification and control of potentially confounding variables, such as those correlated with the program's characteristics and outcome measures. To attend to these intervening factors, measures of the variables noted in the literature as being correlated with either public program participation or sub-optimal birth outcomes were gathered. Particular attention was paid to this issue because so much of the literature on the effects of public programs on birth outcomes do not include sufficient controls and are therefore rendered inconclusive (Shadish & Reis, 1984). Moreover, this control allows for the separation of 'net outcomes' due to program effects from 'gross outcomes' due to extraneous and confounded processes (Rossi & Freeman, 1985), and thereby aids in the rejection of plausible rival hypotheses. In this analysis measures of public program participation rates, sociodemographic characteristics, and medical resources known to be correlated with both the population eligible for the IPO and sub-optimal birth outcomes are used.

A final data consideration addressed here is that of producing population-specific information so that the

evaluation results are useful to program planners and policy-makers. This concern implies that program effects must be measured at levels of analysis that are germane to policy formation, such as the community or state-level (Hatry, Winnie, & Fisk, 1981). Therefore, the IPO's impact on outcomes at the county and participant levels are assessed.

With these methodological considerations in mind, data were gathered and analytic techniques that best addressed the research questions posed were selected. Two methodologicial strategies were chosen to test two hypotheses. The first hypothesis concerns the effect of the IPO on county-rates of sub-optimal birth outcomes. The second hypothesis examines the IPO's impact on outcomes among IPO participants and a matched control group of non-participants.

For both analyses, a data set was created that includes both individual-level birth, infant death and IPO records along with a series of county-level indicators of public program, sociodemographic, and medical resource variables known to be associated with sub-optimal birth outcomes. The following sections describe the research questions, the two types of analyses undertaken, and the data set created to address these questions. The data set described in the first analysis is the core data set of linked birth, death and IPO records used throughout the study. After

describing each analysis strategy, the particular variables and measures selected from the data set for that approach are presented.

Analytic Overview

The ultimate objectives of this study are to assess the impact of the IPO program on rates of sub-optimal birth outcomes and to understand the relationships among public programs, sociodemographic characteristics, medical resources and sub-optimal birth outcomes. To accomplish these objectives, many types of analyses could have been undertaken. For instance, the measurement of the effects of the IPO could have been assessed at the individual level using production function analysis; or county-level trends in outcome rates before and after the implementation of the IPO could be analyzed using an interrupted time series design (Campbell & Stanley, 1963). In this study the IPO's impact on county-level and participant birth outcomes are assessed while controlling for key intervening factors, in order to separate the effects of the IPO from confounding factors and to provide information of use to policy-makers and planners.

Research Questions and Analyses

The first type of analysis undertaken in this study is the estimation of a three-equation, macro-level, structural model. This model is specified to explain rates of prematurity, low birth weight and neonatal mortality as

functions of the IPO program and maternal and county structural risk factors. A three-equation system is estimated because of the expected structural relationships among the dependent variables and the equation errors (i.e., correlated errors among prematurity, low birth weight and neonatal mortality across equations).

The primary question addressed by this analysis is: what is the net impact of the IPO program on rates of sub-optimal birth outcomes at the county-level, controlling for relevant risk factors? This analysis addresses the issue of aggregate program effects rather than participant-specific effects and is undertaken because one of the objectives of the IPO is to reduce overall rates of sub-optimal birth outcomes. Moreover, this question is important from a policy perspective. If public prenatal care programs are able to reduce aggregate rates of sub-optimal birth outcomes, then these programs might receive broader political support.

The second question addressed in this research is: how do rates and changes in rates of prematurity, low birth weight, and neonatal mortality among IPO participants compare to those of a group of non-participants with similar risk characteristics? This question overcomes limitations inherent in the first analysis and is aimed at assessing the program's influence specifically on its target population.

In order to answer this question an appropriate baseline or control group is needed against which IPO participant outcomes can be compared. To overcome the problem of self-selection bias common in program evaluation research (Harris, 1982; Long, 1988; Shadish & Reis, 1984), a control group of non-participants with similar distributions on key sociodemographic characteristics as the IPO population is used. After selecting this group, the rates of sub-optimal birth outcomes among IPO participants and the control group are compared.

These two different methodological approaches are used to evaluate the impact of the IPO program for a number of reasons. Variations in county-level rates of sub-optimal birth outcomes attributed to the IPO program are critical to policy-makers. However, evaluation based on aggregate birth outcomes rather than program participant birth outcomes may mask the effects of the program. Specifically, if the proportion of IPO participants in a county is small, then the impact of the IPO on participant birth outcomes may not significantly impact total county rates because of the small proportion of birth outcomes it represents. Therefore, the county-level analysis provides a useful approximation of the impact of the IPO program at the macro level. A more specific test of the program's impact on participants is accomplished by comparing the experience of the participant population with a synthetic

control group. The specific methodological techniques and data used to complete these analyses are described below.

County Structural Analysis

As just noted, the first method used to assess the effects of the IPO program on sub-optimal birth outcomes is the estimation of a three-equation, structural equation model. In addition to evaluating the IPO's impact on total county rates, this approach was selected in light of the literature highlighting the role played by structural factors in the production of birth outcomes (e.g., Gortmaker, 1979b; Miller & Stokes, 1985; Pampel & Pillai, 1986). This literature consistently points to the effects of poverty and inequality on population health and birth outcomes. Therefore, by using rates of community poverty and other structural variables at the county-level to model sub-optimal birth outcomes, the effects of community (i.e., structural) factors on these outcomes can be examined. As a result, the data obtained from this analysis should be more sociologically interesting and more policy-relevant than, for example, data analyzed at the individual level. In addition, the county is selected as the unit of analysis because in Florida public health planning is done at the district and county level.

The Conceptual Model

Figure 4-1 is a depiction of the relationships modeled in the county structural analysis. The large box in the center of the page represents the county sociodemographic context, which is composed of the race, age, education and income distributions in a community and the impact of these factors on the population and resources within the community. Within this context are boxes representing public programs and medical resources. These factors are placed here because they are known to be shaped by the community context. Specifically, the number of physicians and hospitals in a community are correlated with county income and population size, as are public program participation rates and resources. Therefore, though causal arrows are not drawn from the county sociodemographics to the public program or medical factors, the association among these variables is implied by their placement. The IPO program is placed between the medical and program factors because it is associated with both; the IPO operates in tandem with county public health programs and the medical resources in a community.

To the right of the county context is the set of dependent variables--the rates of sub-optimal birth outcomes. The arrows among these boxes depict the presumed recursive nature of the impact of prematurity on low birth weight and neonatal mortality, and low birth weight on

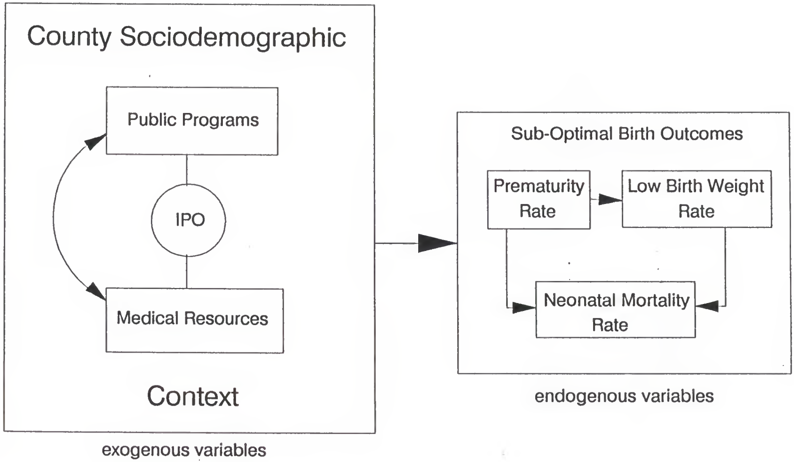

Figure 4-1: Conceptual Model

neonatal mortality. The arrows from the county context to these outcomes represent the impact of the simultaneous effects of the county sociodemographic, program and medical variables on sub-optimal birth outcomes. The individual effect paths between the individual exogenous variables and endogenous variables are implied in this model and are presented parsimoniously in equation form below.

The Statistical Model

The underlying structural relationships between the independent variables and birth outcomes are modeled as a hierarchical, three-equation, recursive system. A system of equations is estimated because of the known relationships among prematurity, low birth weight and neonatal mortality. Moreover, because of the unidirectional nature of the effect of prematurity an low birth weight and, subsequently, the impact of low birth weight an neonatal mortality (i.e., no reciprocal causation), the equations are modeled as hierarchical and recursive (Hanushek & Jackson, 1979). This approach assumes that variables or interventions entered at any point in the system of equations can affect subsequent variables, but not previous variables (Namboodiri, Carter, & Blalock, 1975).

Though either ordinary least squares regression or maximum likelihood estimation could be used to model these relationships, maximum likelihood is selected for its

ability to produce more efficient parameter estimates. Moreover, because the maximum likelihood method uses all the information available from the data, including cross-equation correlation, and because the system estimated is over-identified rather than just-identified (i.e., more than k-1 variables are set equal to zero in the system), this method is recommended over the use of ordinary or two-stage least squares methods (Namboodiri, Carter, & Blalock, 1975).

The three general equations to be estimated are,

EQ. 1 Prematurity Rate = f (IPO participation rates + public program participation rates + aggregate sociodemographic characteristics + availability and use of medical resources) + e

EQ. 2 Low Birth Weight Rate = f (prematurity rates + IPO participation rates + public program participation rates + aggregate sociodemographic characteristics + availability and use of medical resources) + e

EQ. 3 Neonatal Mortality Rate = f (prematurity rates + low birth weight rates + IPO participation rates + public program participation rates + aggregate sociodemographic characteristics + availability and use of medical resources) + e

In these equations each sub-optimal birth outcome is modeled as a function of the IPO program while controlling for the effects of the public program, sociodemographic and medical resource variables, as well as relevant birth outcome rates (e.g., the addition of prematurity in the low birth weight equation). However, because certain variables in each factor are not expected to have a direct effect on all dependent variables, uniquely specified equations are

estimated for each outcome. In particular, the measure of neonatal intensive care utilization is not included in the prematurity or low birth weight equations because these outcomes are temporally prior to nicu utilization. The fully specified models and a discussion of the statistical methods utilized are presented in Chapter Five.

To assure stable rates, it is necessary to have a sufficient number of infant births and deaths in each county. Because a number of the 67 counties in Florida have less than 10 neonatal deaths each year, three years of data are pooled and averaged to assure stability of rates. This approach yields valid estimates of the causal relationships among the exogenous variables and the endogenous variables, assuming that the structure of the relationships have not changed significantly over time.

Interpretation of Results

The results of estimating the system of equations described above will provide evidence of the effects the IPO program on county rates of sub-optimal outcomes in the form of maximum likelihood coefficients and t-test estimates of significance. Both the standardized and unstandardized regression coefficients will be presented in the findings. These coefficients will indicate the relative and scaled (i.e., unstandardized) direction and magnitude of the program's relationship with rates of prematurity, low birth weight and neonatal mortality; they

will also signify the nature of the association between the other predictor variables and these outcomes. The latter information will be useful in supporting or refuting current research on the effects of these variables, and in advancing the understanding of the variables that do influence aggregate levels of maternal and infant health. Of particular interest is the role of variables that are policy malleable. Therefore, programs other than the IPO that significantly influence birth outcomes will be examined in greater detail.

The standardized estimates reported can be interpreted as path coefficients, as in path analysis, representing the standardized effects of one variable on another. Therefore, these estimates could be attached to specific paths added to the conceptual model for a graphical depiction of this information; however, this figure would present redundant data. Therefore, although a path model is not formally presented, path coefficients associated with each predictor and outcome will be presented in a table in the Chapter Five.

The literature suggests that the proportion of births to women in public maternity care may be associated with increased risk of sub-optimal birth outcomes because of the increased risk status of this population (i.e., poverty status). However, if the prenatal care delivered to program participants is sufficient to reduce these risks

substantially, then a negative association between IPO participants and poor birth outcomes will be found. For these reasons, two-tailed hypotheses of the relationship of the IPO, and all variables, with prematurity, low birth weight and neonatal mortality will be tested. These tests will provide information on the significance of these relationships as well as the direction.

To provide additional insight on the effects of the IPO on the outcome variables, the indirect effects of this variable through other variables can be estimated. These figures were calculated, but because they were found to be statistically and substantively insignificant, they are not presented here. The IPO is, therefore, assumed to have no significant indirect effects on sub-optimal birth outcomes.

The next sub-section describes the data set compiled for both analyses in this study. The first section describes the matching of the individual-level data. Subsequent sections describe the county-level information gathered for the county structural analysis. Refinements made for the matched control group analysis are presented in the section that presents that method.

The Data Set

The data set compiled here includes information on each infant born in Florida between 1985 and 1988. These data include records of parents' socioeconomic status, maternal

prenatal care and other medical data. To obtain data on the individual risks of an infant death, Florida death records were matched to these birth records. Next, to assess the role of the IPO while controlling for maternal risk factors, IPO participant records were linked to the matched birth and death records data. These individual-level data are utilized primarily in the matched control group analysis, but they are also used in the county structural analysis by aggregating rates of birth outcome, or the proportion of births to women, with particular characteristics.

Next, because high rates of public program participation, county sociodemographic structure, and limited access to medical resources are known to be associated with increased risk of poor birth outcomes (Cramer, 1987; Institute of Medicine, 1988; Miller & Stokes, 1985), county-level measures of these variables are also included in this data set. Finally, the county-level information is linked to the matched birth/death/IPO program records so that county characteristics can be attributed to the women residing in that county.

The resulting data source is a rich and unique set of information with which causal modeling can be undertaken. This data set is unique in that few data sources contain linked individual and county level data for an entire population. Moreover, few states, if any, have matched

birth and death certificates that have been linked to program participant records.

The information was collected from a variety of sources. The public program data were obtained from the Department of Health and Rehabilitative Services (HRS)--the state's social service agency--in Tallahassee, Florida. County-level socioeconomic data were gathered from the U.S. Census and the Bureau of Economic and Business Research at the University of Florida. Individual-level maternal characteristics and birth outcome data were obtained from the Division of Vital Statistics, Department of HRS. Appendix A describes more fully the sources of each variable.

In the following section, the variables selected for this study and how these data were prepared for analysis are discussed. Table 4-1 is a summary of this discussion. This table presents, as a guide to the following descriptions, the concepts of interest, the measures of these concepts, and a brief operational description of these measures.

Sociodemographic Data

Two levels of sociodemographic data were collected. The data set include individual-level, maternal and infant sociodemographic characteristics from the linked birth/death and IPO records. The second level are county-

Table 4-1: List of Concepts, Measures and Operational Definitions of Measures Used in County Structural Analysis

CONCEPT	MEASURE	OPERATIONAL DEFINITION
PROGRAMS:		
IPO Participation	Number of births to IPO women	Number of IPO births as a proportion of all births
MIC Project Impact	MIC project in a county	Presence of a MIC project
WIC Participation	Number of WIC recipients, by race	Black or White WIC recipients as a % of female population
Family Planning Services	Number of adults using services	Number of participants as proportion of women 15-44
Medicaid Services	Number of adult Medicaid recipients	Number of Medicaid recipients as a proportion of the county population
SOCIODEMOGRAPHICS:		
Maternal Age Risk	Births to women less than 16	Proportion of births to women less than 16
Education Risk	Less than 12 years of education	Proportion of births to women with < 12 years of education
Marital Status Risk	Single mothers	Proportion of women giving birth who are single
Multiple Births	Plural Births	Proportion of births that are multiple births
First Birth	Parity of one	Proportion of first births
Inadequate Prenatal Care	Number of prenatal visits	Proportion of births to women with no prenatal care
County Poverty	Number of poor households	Proportion of households with income < $10,000
AFDC Assistance	Number of AFDC recipient families	Recipient families as a proportion of women 15-44

Table 4-1--continued

CONCEPT	MEASURE	OPERATIONAL DEFINITION
Residence Risk	Population size and density	County ranking on an urban-rural continuum[1]
MEDICAL FACTORS:		
Reproductive Risk	Prior fetal or infant deaths	Proportion of women giving birth who had a prior fetal or infant death
NICU Utilization	Number of nicu bed days	Number of NICU beds used as a proportion of all births
Abortion Services	Number of abortions/county	Abortion rate per 1,000 women 15-44
Obstetrician Availability	Number of licensed Ob/Gyns	Number of Ob/gyns per 1,000 women 15-44

Notes: [1] See Appendix B for a description of this continuum.

level sociodemographic characteristics. Each set is described here.

Birth and death record linking. In Florida infant death records are not routinely linked to birth records. Moreover, infant death among IPO participant births are not recorded nor linked to program records. To undertake the analysis described above, the linking of infant birth and death certificates and the matching of these records to IPO program records was undertaken.

First, data on all individual Florida births and infant deaths between 1985-1988 and IPO participant records from Florida's Client Information System (CIS) were computer linked using a multi-stage procedure. To prepare the Vital Statistics birth and infant death records for matching, the 1985-1988 death tapes were sorted by death certificate number, and all out-of-state deaths were removed. Each year of death records was then compared to the same year and the previous year of birth records for a match on combinations of maternal characteristics in order of decending restrictions.

This procedure involved first comparing records based on the infant's date of birth. All birth certificates that matched to a death certificate on date of birth were then run through the following sets of criteria. If they matched perfectly on the first set, they were pulled and noted as a perfect match. If records did not match on date

of birth, they went to the next level, which matches on mother's county of residence. The criteria used in this first round of matching include infant's date of birth and:

1. infant's last name, gender, mother's last name, mother's county of residence, and race;

2. soundex[1] of infant's last name, gender, soundex of mother's last name, mother's county of residence, and race;

3. soundex of infant's last name, soundex of mother's last name, mother's county of residence, and race;

4. soundex of infant's last name, soundex of mother's last name, and mother's county of residence;

5. soundex of infant's last name, and soundex of mother's last name.

The death records that did not match on these criteria were then compared based on mother's county of residence and the following sets of criteria. [This pass drops the constraint of the same date of birth.]

1. infant's last name, gender, soundex of mother's last name, and race;

2. soundex of infant's last name, gender, soundex of mother's last name and race;

3. soundex of infant's last name, gender, and soundex of mother's last name;

[1]A soundex is a computer algorithm that translates words into numbers based on phonetics. This procedures operates by dropping vowels from words and then assigning numerals to represent letters or sounds. A word is translated into a numeric code attached to the first letter, giving letters that sound similar, the same number code. Using this code, the computer can then compare words that sound alike but may not be spelled alike, allowing for better matching on words that are misspelled. The soundex was included in the linking to improve the percentage of records matched.

4. soundex of infant's last name and soundex of mother's last name and race.

The death records not matching on date of birth or county of residence were then compared on mother's last name. If they matched on mother's last name, they were then compared on the following sets of criteria.

1. infant's last name, gender, mother's county of residence and race;

2. soundex of infant's last name, gender, and race;

3. infant's last name, mother's county of residence and race;

4. infant's last name, gender, and mother's county of residence.

The death records that did not match on any of the above sets of characteristics were then matched on:

1. Date of birth and child's last name; and

2. Date of birth and soundex of child's last name.

After all death records for every year were passed through these matching stages, the matches were checked visually for verification. Non-exact matches and duplicates were removed at this step, and the perfect matches were coded to the birth records by attaching the death certificate number and date.

The Division of Vital Statistics began coding infant deaths on birth certificates in recent years. The completeness of this coding, however, varies dramatically. For example, in 1984, no infant deaths were coded; in 1985,

21 were coded; and in 1986, 1807 were coded. Therefore, the matching procedure described here was first completed without using these vital statistics codes. After the first round of matching was done, however, these vital statistics codes were compared to the matches obtained using the computer algorithm. The vital statistics codes were used to verify perfect matches, or to confirm a match when a death certificate linked to two birth records. This process resulted in the following numbers and percentage of infant deaths linked to births.

Table 4-2: Number and Percentage Matched of Infant Death Certificates to Birth Certificates, Florida 1985-1988

Year	Total Infant Deaths	Number Matched	% Matched
1985	1902	1732	91%
1986	1867	1723	92%
1987	1853	1683	91%
1988	1920	1712	89%

Considering the amount of error present in the reporting and coding of vital statistic data, this percentage match was higher than anticipated. The best previous attempt at linking state infant birth and death certificates, the National Infant Mortality Surveillance (NIMS) project begun in 1984 at the Centers for Disease Control, has resulted in rates of 86% to 100% depending on the quality of the data from the state (Lambert & Strauss, 1987). An increased percentage match is possible by checking paper copies of death certificates not matched to

gather information that may have been missing or mis-coded on the computer file. In addition, contact with county registrars or funeral directors is a remaining method of achieving a near total match. Neither of these procedures were undertaken at this time, though they are planned for future analyses.

Following this matching of birth and death records, these data were then linked to IPO program participant records based on mother's name and social security number. This procedure is described below.

Linking IPO records to matched birth/death records. The Florida Department of HRS was contacted to obtain data from the state Client Information System (CIS--the state's computerized system of social service delivery) on the IPO program. The CIS system records every maternity visit for every IPO client. The HRS Program Office provided this IPO data for the years 1985-1988.

To prepare these records (over 2 million) for matching, they were first were collapsed across all years on mother's name and social security number (which is used as client's identification number) to create a set of total maternity visits for every unique IPO client. This method renders one unique name for each woman, but each woman can have more than one birth in the four year period. Therefore, from the 2 million original records, 134,000 unique IPO women were identified. The individual records that could

not be matched exactly to another name and social security number were dropped because they did not have enough information to match them to a birth record. Unfortunately, the use of this procedure means that the number of IPO clients that were not identified due to incomplete name and social security number cannot be estimated. The number of unique names obtained, however, are true clients.

This file of IPO clients for the years 1985-1988 was then compared to every year of birth records for exact matches. Because the IPO record does not include the same data points as the birth certificate, an alternative algorithm was created to link IPO women to births based on the data available from the IPO record. This algorithm is described below.

Records were compared on each of the following sets of criteria, removing a record that matched from subsequent passes. The criteria were:

1. soundex of client's last name and first name, and social security number;
2. exact social security number;
3. last name, middle initial and first name and county;
4. last name, middle initial and first name;
5. last name, first name, and at least 5 of the 9 social security numbers the same and in the same position.

The total number of births that were linked to IPO client records using this algorithm is 141,639. This number is larger than the number of unique IPO women because a woman may be linked to more than one birth over the four year period. When these birth records are collapsed on mother's name, 99,447 IPO women are identified as linked to one or more birth certificates. With this information, the birth certificate records were marked with a code to identify which births were to an IPO participant. These records were then sorted by year to render the total number of IPO clients and IPO births per year. To check for bias in the linking of IPO clients to birth records, the distribution of select characteristics among the IPO linked and non-linked records were compared. The means and frequencies for these variables are presented below.

Table 4-3: Means and Standard Deviations of Selected Variables for the Matched and Unmatched IPO Records, 1985-1988 Pooled Florida Data

Variable Mean and Standard Deviation	Matched	Unmatched
N	99,447	34,553
Family Income ($)		
Mean	1655.28	1611.39
Standard Deviation	3084.39	3047.62
Family Size		
Mean	2.90	2.79
Standard Deviation	2.90	3.21

These comparisons show no important difference between the clients who did and did not match to birth records. Based on these results it was concluded that the matched

group of IPO women represent an unbiased sample of IPO women and can be used for comparison purposes in this study.

In addition, to check for county-level biases in the number and percentage of IPO clients matched to birth records that would be due to variation in recording accuracy, the distributions of matched women across counties were calculated. This check indicated that there is little variation in the match across counties; most counties have record matches between 70-80%. The counties that had lower percentages were typically smaller counties where one no-match would reduce the percentage match disproportionately. It was concluded from this check that there is no significant county selection bias present in the IPO group that is linked to birth certificates.

With these linked birth and death records, birth year cohorts were created that contain Florida birth records for 1985-1988 linked to infant deaths and IPO participant records. Table 4-4 is a summary of the distribution of births and neonatal mortality for the IPO and non-IPO linked groups. This table provides an important summary of the differences in the IPO and non-IPO participants. For example, the percentage of births to black women in the IPO program is nearly 40% in 1988. In contrast, among white births, the proportion of infants born to IPO women is less than 18%. This difference is expected to be the result of

Table 4-4: Summary of Births and Neonatal Deaths Among IPO and Non-IPO Births, from Linked Birth, Death and IPO Records, 1985-1988

YEAR and VARIABLE	Black IPO	Black Non-IPO	Black Total	White IPO	White Non-IPO	White Total
LIVE BIRTHS[1]						
1985	13134 33.9%	25618 66.1%	38752 100%	16552 13.3%	107636 86.7%	124188 100%
1986	14983 38.1%	24352 61.9%	39335 100%	20359 16.0%	107008 84.0%	127367 100%
1987	15110 36.3%	26546 63.7%	41656 100%	19539 14.7%	113192 85.3%	132731 100%
1988	16692 38.3%	26837 61.7%	43529 100%	23903 17.3%	114224 82.7%	138127 100%
NEONATAL MORTALITY[2]						
1985	13.5 (177)	11.0 (282)	11.8 (459)	8.0 (132)	5.7 (618)	6.0 (750)
1986	12.8 (192)	11.7 (284)	12.1 (476)	8.4 (171)	5.4 (578)	5.9 (749)
1987	8.7 (131)	10.0 (265)	9.5 (396)	4.4 (87)	4.4 (498)	4.4 (585)
1988	9.3 (155)	11.9 (319)	10.9 (474)	5.6 (134)	5.1 (580)	5.2 (714)

Notes:

1 The top number is race and group-specific live births, the bottom number is the percent of total race-specific births.

2 The top number is the race and group-specific neonatal mortality rates per 1000 race-specific live births; the bottom number is the number of neonatal deaths.

socioeconomic differentials across the white and black populations in Florida. Additionally, the rates of neonatal mortality among black infants is 9.3 compared to the white neonatal mortality rate of 5.6. These descriptive data provide evidence of the need for race-specific analyses in birth outcome research.

From this micro-level data set a number of variables were selected for analysis. Reported at the individual level, these measures were aggregated to the county-level based on mother's county of residence, and/or to the group-level based on IPO participation. These variables are described below.

Maternal sociodemographic variables. In light of the research on the association of maternal risk factors and poor birth outcomes, the following maternal sociodemographic variables were selected for analysis from the linked birth, death and IPO data base.

1. Maternal race
2. Maternal age
3. Maternal education
4. Number of prenatal visits
5. Plurality (the number of infants delivered)
6. Parity (the birth order of the infant)
7. IPO participation (yes or no)

All maternal variables are race-specific: black or white. Non-white and non-blacks birth were not included in this analysis because the literature indicates that the outcomes among these persons are significantly different from blacks and whites. Because their numbers are so

small, however, analysis of these data using the methods employed in this study is impractical.

The proportions of black and white births in each county that fall into the above categories were calculated to provide county-level measures of the incidence of these characteristics. For example, the proportion of births to women less than 16 years of age is calculated to measure maternal risk due to young age. The distributions of the variables--their means, standard deviations, and ranges--are presented in Table 4-5 for blacks and 4-6 for whites and are discussed throughout the text. In addition, reference to Table 4-1, noted earlier as a summary of these variables, may be useful.

Maternal sociodemographics. The first maternal sociodemographic variable included in the county structural analysis is the proportion of births to women less than 16 years of age. This measure is calculated by dividing the total number of black and white births to women less than 16 in a county by the total number of race-specific births in that county. As presented in the second panel of Table 4-5, the average proportion of births to black teens in Florida between 1986 and 1988 (calculated by taking the mean of the 67 county values) is 38.09%. Among white teens (panel two in Table 4-6), this proportion is 9.07%--a

Table 4-5: Means, Standard Deviations and Ranges for County Structural Model Variables for Black Births, 1986-1988 Data

FACTOR/ Variable	Mean	Standard Deviation	Range
OUTCOMES:			
Prematurity	14.00	3.39	4.00-21.3
Low Birth Weight	12.29	2.49	4.00-17.39
Neonatal Mortality	10.93	9.53	0.0-56.60
PROGRAM:			
IPO Births/Total Births	40.46	18.12	7.03-83.33
MIC Project	.07	.26	.00-1.00
WIC Participation	11.5	9.54	3.57-56.95
Family Planning	6.71	4.26	0.09-19.65
Medicaid	7.20	3.92	2.5-17.18
SOCIODEMOGRAPHIC:			
Births to teens	38.09	16.84	0.00-86.54
Birth to women with less than 12 years education	36.74	8.23	16.00-57.46
Births to single women	65.99	8.17	40.86-85.58
Multiple Births	2.20	1.59	0.00-7.55
Parity of one	34.68	6.03	15.00-55.56
No Prenatal visits	5.89	4.44	0.00-25.00
Poor Households	24.35	6.06	14.13-36.6
AFDC Recipients/1000 women	3.87	2.45	0.06-10.0
Urban-Rural Residence	11.61	4.32	1.00-17.00
MEDICAL:			
Reproductive Risk	8.62	3.67	0.00-22.22
NICU Utilization	98.90	20.55	65.86-179.21
Abortions/1000 Women	29.30	9.28	15.20-71.46
Ob/Gyn's per 1,000 Women	0.28	0.27	0.00-1.08

Notes: N = 67; Data are county-level measures from pooling and averaging 1986-1988 Florida iindividual and county data.

Table 4-6: Means, Standard Deviations and Ranges for County Structural Model Variables for White Births, 1986-1988 Data

FACTOR/ Variable	Mean	Standard Deviation	Range
OUTCOMES:			
Prematurity Rate	6.38	1.24	2.91-9.82
Low Birth Weight Rate	6.25	1.02	4.38-10.18
Neonatal Mortality Rate	5.20	2.56	0.00-13.69
PROGRAM:			
IPO Births/Total Births	20.83	9.43	6.87-52.24
MIC Projects Availability	.07	.26	.00-1.00
WIC Participation	2.96	1.45	.26-6.74
Family Planning	6.71	4.26	.09-19.65
Medicaid	7.20	3.92	2.5-17.18
SOCIODEMOGRAPHIC:			
Births to Teens	9.07	5.84	1.83-29.07
Births to Women with less than 12 years education	26.04	9.44	10.85-55.26
Births to Single women	16.23	3.26	8.51-22.32
Multiple Births	2.11	.68	.00-4.79
Parity of one	43.22	2.96	36.02-48.25
No Prenatal visits	3.37	3.05	.31-16.99
Poor Households	24.35	6.06	14.13-36.6
AFDC recipients/1000 women	3.87	2.45	.06-10.0
Urban-Rural Residence	11.61	4.32	1.00-17.00
MEDICAL:			
Reproductive Risk	5.90	1.41	2.5-9.18
NICU bed days/births	98.90	20.55	65.86-179.21
Abortions/1000 women	29.30	9.28	15.20-71.46
Ob/Gyns 1,000 women	.28	.27	.00-1.08

Notes: N = 67; Data are county-level measures from pooling and averaging 1986-1988 Florida iindividual and county data.

dramatic differential from the blacks. Moreover, This proportion ranges from 0-86% among blacks and 1.8-29% among whites.

A measure of the proportion of births to women with less than 12 years of education is included as a measure of structural risk due to low education. This variable is also race-specific. The mean value of births to women without high school diplomas is 36.7% for blacks, with a range of 16-57%, and 26% for whites with a range of 10.8-55%. These figures highlight the high association between low education and childbearing among black women.

Racial differences in the distribution of risk characteristics is also noted when examining marital status. The proportion of total births that are to single women is the third county maternal risk characteristics included in the structural analysis. Among black women, the average proportion of births to single women is almost 66%. By comparison, the percentage of births to white single women is 16.2%. Moreover, this difference is not a result of outlier counties; the race-specific ranges of this variable are 40.8-85.5% for blacks and 8.5-22.2% for whites.

Measures of the proportion of race-specific, county births that are plural (i.e., multiple births, such as twins) and that are first births (i.e., parity of one) are also included in the structural model because of the

increased risks of sub-optimal outcomes associated with their presence. For example, twin births and first births are both associated with higher risks of prematurity and low birth weight, especially among black births. The average proportion of black multiple births in this data set is 2.20 and the average proportion of first births is 34.68. Among whites these figures are 2.11 and 43.22.

The last maternal characteristic included in this analysis is the proportion of births to women with no prenatal visits. This measure is utilized because of the hypothesized relationship between prenatal care and improved birth outcomes. It is expected that the larger the proportion of women in a county who have had not prenatal care, the higher the incidence of sub-optimal birth outcomes. This measure is used rather than an adequacy of care measure because of the known limitations of these scales. For example, in the past, researchers used trimester of entry into prenatal care as a criterion of quality of care; yet this information is known to be poorly recorded on birth certificates. Moreover, when the bivariate relationship between entry into care and sub-optimal birth outcomes is examined, a pattern of improved outcomes among third trimester entry births is noted. This relationship is probably due to the fact that women who have had other children or who are healthy often wait until

the third trimester to enter care. Therefore, this measure is not a good indicator of increased risk.

The average proportion of women in a county with no prenatal visits is 5.89 for blacks and 3.37 for whites. It is noteworthy that, among blacks, the upper end of this variable's range is 25. This value indicates that, in at least one county, 25% of women bearing children have no prenatal care. Among whites this measure ranges to 16.99--a disturbingly high statistic, though still lower than the black experience.

These data point to the relative disadvantage of black women in accessing medical services and, as a result, their higher risk of sub-optimal birth outcomes. All of these maternal sociodemographic characteristics are expected to be positively related to sub-optimal birth outcomes, but the effects of these risks are expected to be attenuated among black birth outcomes.

County socioeconomic variables. To measure important aspects of the community structure (i.e., aggregate social characteristics of a community that constrain the health behavior of residents) that are associated with poor birth outcomes, indicators of county poverty, welfare program participation, and residence type (i.e., rural or urban) are included. Specifically, measures of the proportion of households with less than $10,000 annual income, the number of AFDC recipient families as a proportion of women of

childbearing age, and the degree of urbanity or rurality of a county (using a 17 point continuum, described in Appendix B) are used. Because it is reported in the literature that increased rates of sub-optimal birth outcomes are associated with increased community poverty (Gortmaker, 1979b), concentrations of social program participants, and increased rurality (Baker & Kotelchuk, 1989), indicators of these characteristics are expected to be positively associated with poor birth outcomes in this research.

The first indicator--the number of households with less than $10,000 annual income--is selected as the measure of community poverty because it is one of the few current measures of income available at the county level (i.e., the Census provides estimates based on 1980 data only). Moreover, even though this measure does not adjust for household size, it is a better indicator of county poverty than county median or per capita income because of the concentrations of very wealthy and very poor families in many of Florida's counties. For example, because of the numbers of wealthy persons in Sarasota or Palm Beach counties, a measure of median income would severely underestimate the extent of poverty in these areas. The mean value for the poverty indicator used is 24.35 with a range of 14-36, indicating the extent of households with low incomes in the state.

The second measure selected--the number of AFDC recipient families as a proportion of women of childbearing age--is used as another indicator of county poverty for two reasons. The first reason is simply that this indicator is a reasonable measure of the number of poor female-headed households in a county. Secondly, because the AFDC population is nearly 95% female and because the concern of this study is with birth outcomes, this variable provides a useful measure of program participation among women of childbearing age. The mean value for this variable is 3.87, or an average of 3.9 AFDC recipients for every 1,000 women 15-44.

Finally, a measure of county population size and density is included as a third measure of the sociodemographic context. Specifically, this variable is used in the structural models to control for known variations in economic and medical resource distributions across residence types, and to control for the correlation of these distributions and residence with sub-optimal birth outcomes (i.e., higher rates of infant mortality are found in nonmetropolitan as compared to metropolitan areas) (Rosenbaum & Hughes, 1989). This scale categorizes counties on a continuum ranging from 1 (most metro) to 17 (most rural) based on SMSA classification and population size.

Public program variables

In response to the literature concerning the association of public program participation and birth outcomes, all available measures of relevant program participation rates in Florida were gathered for this study. Data on the IPO program, MIC projects, WIC, AFDC, and Family Planning participation were obtained. All variables, with the exception of the IPO program variables, are measured at the county level and most are measures of the number of individuals participating as a proportion of the total population or female population of childbearing age. Data on the IPO and WIC programs are race-specific, but none of the other variables were available in this form; therefore, all other program measures represent all races combined.

IPO participation. To measure the influence of the IPO at the structural level, an indicator of the proportion of county births that are to IPO women was created. This measure was selected to indicate the degree of program size and penetration in a county. Because, as noted earlier, data on the number of women in each county who are in need of or eligible for IPO services are not available, this measure of births to IPO women is used as an indicator of the extent of program participation. To create this variable, the individual level IPO data were linked to birth and death certificate data and aggregated to the

county level. All births flagged as an IPO birth were counted and this total number was divided by the total number of births. This procedure was done for blacks and whites separately. Other non-white births are, therefore, dropped from the IPO and total birth counts.

Because the match of the IPO records to the birth records described earlier was relatively low (approximately 75%), this measure is expected to be an underestimate of true proportion of the births that are to IPO participants. An alternative IPO measure is one that utilizes the number of IPO participants, as reported quarterly by each county, as a proportion of all women of childbearing age. However, because a number of IPO participants are known to discontinue their prenatal care, many may have a stillbirth or fetal death (both of which are not considered live births), and some will have twins, this count of participants is not an accurate estimate of the number of women who truly participate and give birth as an IPO client. Moreover, the number of women of childbearing age, as a denominator, would be a gross over-estimate of the number of pregnant women in a year. Although some alternative methods of addressing these data limitations are available, such as the application of state-level fertility rates to the number of women of childbearing age in each county to obtain an estimate of pregnant women, the

proportion of births to IPO women was selected as the most accurate estimate available.

The mean value of IPO participation is 40.46% for blacks, with a range of 7.0-83.3%. Among white births, the average participation rate is 20.8% with a range of 6.8-52.34%. These figures show that black women compose a larger proportion of IPO participants than white women. This distribution is expected to be caused by the higher rates of poverty and lower rates of health insurance coverage common among the black population.[2]

MIC projects. MIC project availability is a dichotomous measure of the presence of a MIC project in a county. As noted earlier, 12 of Florida's 67 counties had initial MIC projects. The presence of a MIC project is believed to have a positive impact on improving birth outcomes through the creation of systems to deliver maternity care in counties that would otherwise not have a

[2] It should also be noted that a measure of the county expenditures per IPO client was considered for inclusion in this analysis. The data available for this measure included the total county expenditures per year, and the number of reported participants. However, because it is possible for health departments to shift expenditures across service areas regardless of where the funds are budgeted (i.e., IPO money can be spent on vaccination or family planning services, if desired), the expenditure figure is not considered an accurate estimate of county spending on IPO participants. Moreover, because staff salaries, administrative costs, and the other overhead charges that go into the costs of delivering medical services vary so dramatically across counties (i.e., medical services cost more in urban areas than in rural areas), the dollar amount of expenditures per client is not equivalent across the state. For these reasons this measure was omitted from the analysis.

system prior to the IPO. Therefore, counties that have a MIC project are expected to have lower rates of sub-optimal birth outcomes because of the history of maternity care in their county.

WIC participation. The influence of WIC program participation on birth outcomes is measured using the number of black and white WIC recipients as a proportion of black and white women of childbearing age. The number of women 15-44 was selected as the denominator in this measure because of the lack of available measures of either the number of pregnant women and children eligible or in need of WIC food supplementation. Examination of the distribution of this variable by race shows that there are interesting racial differences. The mean value for blacks is 11.50 compared to 2.96 for whites, indicating that, as noted with the IPO variable, a larger proportion of black women are enrolled in the state-supported WIC program than are white women.

Family Planning participation. The number of adults who utilize public family planning services as a proportion of women of childbearing age is utilized as a measure of family planning services. Total women of childbearing age is used as the denominator for this measure because measures of women or adults in need of state family planning services are not available. Moreover, because the data indicate that a majority of the people who utilize

public family planning services in Florida are women, and because the interest of this study is on the effects of programs on pregnant women, the number of women of childbearing age is considered an appropriate denominator for this measure. The mean value for this variable is 6.71, with a range of .09-19.65, indicating considerable variability in the utilization of public family planning services across counties in Florida.

Medicaid. The last public program variable included in this analysis is a measure of Medicaid participation in a county. This variable is included because of the known relationships between Medicaid enrollment and medical utilization, and, in particular, between Medicaid enrollment and IPO participation. Medicaid enrollees are automatically eligible for IPO services in the state of Florida. Moreover, those women who are already 'in the system' or who are considered Medicaid eligible, are more likely to be in the IPO program than other women. Therefore, the number of Medicaid recipients as a proportion of women 15-44 is used as an indicator of Medicaid participation in each county. The mean value of this indicator is 7.20, with a range of 2.50-17.18. As with most of the program variables, Medicaid enrollment rates vary across the state.

Medical variables

The variables included in this analysis to measure the availability and use of county medical resources are the number of neonatal intensive care unit bed days, the number of abortions per 1000 live births, and the number of licensed Obstetrican/Gynecologists in a county. The first two variables, though collected at the county level, were collapsed to the district level because nicu beds and abortions are not available in all counties in Florida. The district average for these variables was then allocated to every county in the district.

NICU utilization. Because of the importance of neonatal intensive care to the survival of premature and low birth weight infants (U.S. Congress, Office of Technological Assistance, 1987), a measure of the utilization of neonatal intensive care across the state is included in this study. Neonatal intensive care utilization is measured as the number of total beds used that are NICU beds, divided by total live births in the county. NICU utilization is known to be highly associated with improved birth outcomes and is, therefore, expected to be negatively associated with the dependent variables in this analysis. For the years 1986-1988, the average NICU utilization rate per 1,000 live births is 98.90, with a range of 65.86-179.21.

Abortion rate. A measure of the number of abortions in a district as a proportion of women of childbearing age is included because of the relationship between abortion availability and improved birth outcomes (Joyce & Grossman, 1986). In Florida, the average number of abortions per 1,000 women in a county is 29.3. The range of this variable is between 15.2 and 71.46.

Obstetricians per female population. The final medical resource variable selected for this analysis is the number of licensed obstetrician/gynecologists per 1,000 women of childbearing age in a county. This variable is included in the county structural analysis because of the relationship between the number of Ob/gyns and the delivery of prenatal care. Hence, the fewer the obstetricians in a county, the less the availability of prenatal care, and the higher the rates of sub-optimal birth outcomes (Rosenbaum & Hughes, 1989). In some counties in Florida, there are no practicing obstetricians. As a result, women in these counties have to travel to a neighboring county to deliver, which may increase the risks of a complicated birth.

The availability of Ob/Gyns has become a critical issue in maternal health and birth outcome research recently because of the dramatic declines in the number of these physicians providing obstetrical care in the U.S. in the past decade. These declines have been in response to the increasing number of claims against Ob/Gyns--two to three

times more than among all other physicians--and the resulting increased costs of liability insurance for obstetricians--malpractice premiums for Ob/Gyns increased 113% between 1982 and 1985 (Institute of Medicine, 1989). Therefore, the inclusion of this variable is expected to control for variations in sub-optimal birth outcomes that are due to the reduced availability of obstetrical care.

The following section discusses, in detail, the second analytic strategy used to assess the effects of the IPO program. This section outlines the rationale and techniques for selecting the matched control and other comparison groups, as well as how this approach permits the valid assessment of the IPO's effects on participant outcomes.

Comparison Group Analysis

To assess the IPO program's effect on birth outcomes among participant births, a quasi-control group was created from the population of non-participants as a comparison group against which to compare participant outcomes. This set of non-participants is a 'quasi'-control group because they are not a control group in a strict experimental sense. Moreover, they do not represent a non-equivalent control group, as described by Campbell and Stanley (1963), because the pre-intervention measure criteria is not met. Instead, a synthetic matched comparison group is constructed by randomly selecting a group of non-IPO

participants who are distributed proportionately to the IPO population across simultaneous categories of race, age, education, marital status and the number of prenatal visits. The following section describes the procedure used to create this synthetic, matched comparison group.

Matched Control Group Selection

A comparison group of women not enrolled in the IPO program was selected from the total non-IPO population based on five key risk characteristics: maternal race, maternal age, maternal education, marital status and the number of prenatal visits. These variables were selected as matching criteria because of the preponderance of evidence documenting their association with sub-optimal birth outcomes (Cramer, 1987; Institute of Medicine, 1985, 1988; McCormick, Shapiro & Starfield, 1984).

To construct the control group so that it would have equivalent distributions across the simultaneous risk categories, the selected variables were first cross-classified (i.e., race by age by marital status, etc.) to produce a typology or matrix of exhaustive and mutually exclusive categories. To insure efficiency, all variables were made categorical to keep the number of cells to a minimum and to minimize problems of small cell sizes. Based on the literature reviewed in Chapter Two, race was collapsed to black and white, and marital status was

divided into married and unmarried (i.e., including single, divorced, and widowed).

The variables that were continuous (and, hence, needed to be made categorical) were examined for important break points. Specific categories were determined by utilizing empirically-relevant cut points. This empirically driven categorization was necessitated by the inconsistency in the literature regarding definitive risk cut points for each of these variables. Further, because Florida data are analyzed in this study, it was important to establish risk categories based on empirical distributions among Florida's population. Although standard categories of education and age based on socially-relevant cut points (i.e., high school education) could have been created, examination of the data indicated that these break points were not always relevant to the risk of a poor birth outcome. Therefore, if this categorization scheme was used, the true risks of certain years of education or age would have been understated (i.e., high risk values would have been underweight if they were grouped with low risk values). The categories were thus determined empirically using the Florida, race-specific data.

The rates of neonatal death for each value (i.e., each age or each year of education) of the continuous variable were calculated and plotted using 1985-1987 pooled data. Three years of pooled data were used to obtain larger

numbers and, hence, more stable rates of mortality for each value of the independent variables (i.e., the rate of neonatal death among women 15 years of age or with 10 years of education).

First, the rates of mortality for each year of age were analyzed for homogeneous risk categories. These trends indicated that among black births the risks of neonatal mortality are greater among women who are less than 19 or greater than 42 years of age. For whites the risks are higher for women less than twenty or greater than 41. Based on these findings, the age variable was collapsed to two categories for each race: those less than 19 or greater than 42, and all others for blacks; and those less than 20 or over 41, and all others, for whites.

The relationship between neonatal mortality and years of education also show racial differences in risk categories. Specifically, black women with 12 years of education or less are at a greater risk of having a neonatal death than black women with more than 12 years of education. Among white women, those with less than 12 years of education are at a greater risk of a neonatal death than those with 12 or more years of education. From these findings, the categories of education created for the selection of the matched control group are: 12 years or less versus more than 12 years for blacks; and less than 12 years versus 12 or more years for whites.

Next the relationship between neonatal mortality and the number of prenatal visits was examined for important risk break points. These data indicated that black and white women with fewer than seven prenatal visits experience similar increased rates of neonatal mortality compared to those with 7 or more visits. Therefore, the categories for this variable are specified as less than seven visits, and seven or more visits. The categorization of this variable is consistent with the literature on the number of prenatal visits that are considered 'inadequate' and 'adequate' (Institute of Medicine, 1988).

With all of the variables categorized and cross-classified by these variables, 32 cells of simultaneous risk categories (race x age x education x visits x marital status) were created. The distribution of the IPO population across these cells was determined, and, based on these distributions, a random sample of non-IPO women was drawn for every cell in proportions equal to those of the IPO group. Because the characteristics of the non-IPO population are different from those of the IPO group, some of the non-IPO cells have observations insufficient to obtain proportions equivalent to the IPO group. In this case, cells with inadequate sizes are weighted by a factor (that ranged between 1 and 4) sufficient to achieve the necessary distribution of non-IPO women in each cell.

This selection procedure was completed on each individual year of births, rather than pooled years, between 1985 and 1988, so that changes in the distributions of IPO women on these risk factors over time would be captured and explicitly included in the construction of the matched control group. The distributions of IPO and matched control group women across the simultaneous categories of risk for each year of data (1985-1988) are presented in Appendix C. These tables present the unweighted distributions of the matched control group.

The non-IPO births that were not selected for the matched control group (i.e., if there were more women in that cell than were needed to replicate the IPO distribution) are categorized in a group referred to as the 'residual' group. This group of women is expected to have higher levels of education, is more likely to be married, and have higher amounts of prenatal care than either the IPO or matched control groups. Therefore, this group serves as an 'ideal', low-risk population of women, against which the birth outcomes among the IPO and the matched control group can be compared.

In addition, an aggregate, race-specific group of all women in these groups (i.e., the total number of women bearing children in the state) is created. The rates of prematurity, low birth weight and neonatal mortality among this total population are also used in this comparative

analysis as measures of state birth outcome trends over time. These data are critical to the interpretation of sub-population trends because they provide a baseline measure of the relative changes in total population outcomes over the time period reviewed.

Examination of the group distributions across simultaneous risk categories presented in Appendix C indicate interesting differences between the IPO and non-IPO (i.e., the matched control and residuals) groups. In particular, because the residual group represents those women with characteristics most unlike the IPO (i.e., by virtue of their non-selection into the matched group), the clumping of these women into the categories of white, age greater than 19 and less than 42, more than 12 years of education, and adequate prenatal visits implies that the IPO women are at greater risks of sub-optimal birth outcomes than the non-IPO. From the distribution of the IPO women we can see that this is true. In 1988, only 11.8% of black IPO women and 8.2% of white IPO women had none of the risk characteristics measured here.

To further examine the distribution of individual risk characteristic among these three groups, Table 4-7 presents summary measures of the variables across each group. The figures for the matched control group are the <u>unweighted</u> numbers. These data show the similarities among the IPO and matched control groups on the distributions of the key

Table 4-7: Univariate Frequencies on Selected Variables Among the IPO, Matched Control and Residual Groups, Florida Data, 1985-1988

Variable and Group	Year 1985	1986	1987	1988
N-Size				
IPO	30,036	34,548	34,277	40,120
Matched[1]	73,491	70,754	76,257	77,506
Residual	61,251	59,186	63,449	63,822
Black Race[2]				
IPO	43.7%	41.9%	43.4%	40.7%
Matched	32.4%	31.4%	32.6%	32.2%
Residual	2.9%	3.2%	2.6%	2.4%
Age[3]				
IPO	22.9	23.3	23.3	23.3
Matched	25.0	25.2	25.2	25.5
Residual	27.5	27.7	28.0	28.2
Education[3]				
IPO	10.7	10.8	11.1	11.0
Matched	11.8	11.9	11.8	11.8
Residual	13.5	13.6	13.6	13.6
Marital Status-Single[2]				
IPO	52.1%	53.4%	56.1%	55.4%
Matched	35.3%	35.7%	37.1%	38.2%
Residual	1.0%	.8%	.9%	.4%
Prenatal Visits[3]				
IPO	8.7	8.9	9.1	9.5
Matched	9.7	9.9	10.2	10.0
Residual	12.1	12.4%	12.4%	12.6

Notes:

[1] Values are from the unweighted matched control group.
[2] Expressed in percentages.
[3] Expressed as the mean value for each group.

variables indicating the success of the matching procedure, and confirming the expectation that the characteristics of the residual group are very different from the IPO or the matched control group.

In the first three rows of Table 4-7 the population sizes of each group are presented. The percent black population measure shows clearly the skewed distribution of black women in the IPO group. The distributions of age, education and marital status provide further evidence of the increased distribution of risks among the IPO population. In particular, IPO women have a mean education level between 10.7 and 11.0 (depending on the year examined). Moreover, IPO women are more likely to be single (between 52.1% and 55.4%) than non-IPO women (35.3 - 38.2%). In addition, these women have, on the average, fewer prenatal visits than non-IPO women (9.5 visits among IPO women compared to 12.6 visits in the residual group in 1988).

With the appropriate matched comparison and residual groups selected for comparison purposes, a brief discussion of the analysis of these data is presented. Following this section is a summary of the information presented in this chapter. In Chapters Five and Six the findings from each of the analyses described here are presented.

Comparison group analytic strategy

The key assumption in this analysis is that, because key risk factors in the matched group selection have been controlled, these two groups have the same or very similar risk of poor birth outcomes and are approximately equivalent except for IPO program participation. This assumption allows for the development of conclusions concerning the program's impact based on simple comparison of the birth outcome rates and trends in these rates over time. It is expected, for example, that if the IPO program has an impact on IPO participant outcomes, then the rates of low birth weight and infant mortality will be lower among this population than among the matched group. Moreover, it is anticipated that the rates among the IPO population will decline over time, due to improved program implementation with increased tenure, and that the declines will be greater than those found among the matched control group.

These hypotheses will be tested in this analysis by comparing rates and trends. There is, however, no statistical test for the formal comparison of these rates, or the rates of change among these groups, because the key assumption of independent selection of groups in a standard test is violated (Blalock, 1979). The differences in the rates of change over time will, however, be calculated and compared.

Summary

This chapter presented detailed discussions of the analytic techniques selected for this study and the rationale for their selection. Also described were the creation of the data set and the measures used for each analysis. In this discussion, the unique nature of the data set was highlighted in order to emphasize the relevance of the findings produced and the need for more comprehensive data collection and analysis of the variables that impact maternal and infant health. In the next chapter the results of estimating the county structural models are presented.

CHAPTER FIVE
COUNTY STRUCTURAL MODELS
FINDINGS AND DISCUSSION

This chapter presents the results from estimating the county structural models. This county-level analysis centers on the interpretation of the coefficients from the prematurity, low birth weight and neonatal mortality equations, with the primary goal of assessing the role of the IPO program on these outcomes. In addition, the impact of other program, sociodemographic and medical service variables on county-level sub-optimal birth outcome rates are reviewed in order to better understand the community structures which shape birth outcomes and alternative means of improving birth outcomes in the U.S. Before these findings are discussed, the zero-order correlations among all variables included in the county structural equations are presented.

Correlations Among Country Structural Variables

To understand the relationships among the IPO measure, the control variables, and sub-optimal birth outcomes, the race-specific, zero-order correlations among all of these measures were calculated. These results are presented in Appendix D for the black population data and Appendix E for the white population data.

The IPO and County Structural Variables

The first column of Appendix D suggests that, at the bivariate level, the percent of births that are to IPO women is negatively correlated with Medicaid and AFDC participation rates (-.28 and -.27, respectively). These findings suggest that in counties where Medicaid and AFDC participation rates are low, IPO enrollment is high. One way to interpret these data is to posit that the IPO may be filling a welfare service gap for black women by providing more prenatal services in those counties where welfare services are at a minimum. Specifically, counties with fewer resources for other public programs may receive increased IPO funding to meet the needs of the population. Considering the social service budgetary constraints in Florida, and the disparity in health services in rural parts of the state, this explanation is particularly plausible. Evidence confirming this hypothesis was not collected for this study.

Among white births, conversely, Medicaid and AFDC participation are positively related to IPO participation levels (.18 and .11, respectively), suggesting potential racial disparities in the impact of the IPO. For this population, IPO participation correlates highly with family planning participation(.39), the proportion of births to women less than 16 years of age (.43), low maternal education (.46), single motherhood (.25), the percent of

poor households (.45), rural residence (.35), and the proportion of women who have had a prior fetal death (.25). These findings suggest that for whites increased IPO enrollment may be associated with lower levels of community socioeconomic status and increased risk of sub-optimal birth outcomes (Alan Guttmacher Institute, 1984; Brooks, 1980; Geronimus, 1987; Rosenbaum & Hughes, 1989). As also noted in this correlation matrix, rates of teenage childbearing are positively associated with poverty (.62), AFDC participation (.45), rurality (.44), and low birth weight rates for white women. Thus, teenage births may, as suggested by Geronimus (1987), be mediating the relationship between structural disadvantage and poor birth outcomes for whites. The effects of births to young women net of these correlated factors will be examined in the county structural model presented below.

The IPO participation variables for whites are also significantly and negatively correlated with the proportion of first births (-.40), and with the Obstetrician-to-population ratio in a county (-.40). The correlation with Ob/Gyns is interesting and suggests a number of interpretations. One hypothesis is that in counties where obstetricians are not widely available (or may not be available at all), the IPO program is undoubtedly the main source of maternity care. Thus, in these counties a larger proportion of all births are to IPO women. In addition, as

found in Appendix E, the negative correlation between obstetricians and rural areas (-.56) further suggests that this relationship is particularly acute in rural counties.

Moreover, the positive correlation between family planning participation and IPO enrollment (.39) also lends support to this association of residence, medical resources and the IPO. To wit: the fewer the obstetricians in a community, the greater the reliance on public contraceptive services. In addition, correlations of Family Planning participation rates with Medicaid enrollment (.58), poor households (.62), AFDC participants (.71) and rurality (.58) all confirm the expected relationships among rural residence, poverty, and reliance upon public program; as do the associations of Medicaid with poverty rates (.85), AFDC participation (.83), rurality (.50).

Birth Outcomes and County Structural Variables

Returning to the black births, the correlations of sub-optimal birth outcomes with the exogenous variables will now be examined. At the bivariate level, the IPO measure is not significantly relatated to any of the sub-optimal birth outcome rates. However, associations of interest are found between family planning and low birth weight rates (-.25), teenage childbearing and low birth weight (.29), low education with increased prematurity and low birth weight (.38 and .27), plurality with all three sub-optimal birth

outcome rates (.46, .47, and .29), and poverty and reproductive risks with neonatal mortality (.25 and .45).

All but one correlation between the county structural variables and birth outcomes is in the direction suggested by the literature. The association between WIC participation rates and neonatal mortality among blacks (.30) was not anticipated. Although the literature focuses on the effects of WIC on low birth weight and prematurity, the expected relationship of WIC with neonatal mortality is negative. The positive correlation could be due to uncontrolled covariation among WIC participation and other at-risk variables. The partialed relationship between these measures will be examined in the next section.

Prematurity rates among blacks are associated with higher proportions of women with low education (.38) and plural births (.46). Low birth weight rates are lower with increased family planning participation rates (-.25) and rural residence (-.25), and higher in counties with greater concentrations of young mothers (.29), higher concentrations of women with little education (.27), and plural births (.47).

Finally, higher rates of WIC participation (.30), plural births (.29), poor households (.25), and women with reproductive risks (.45) are correlated with increased neonatal mortality rates among blacks. None of the medical

resource variables examined served to reduce the risks of neonatal deaths among this population.

Turning to white birth outcomes, the following relationships are noted: low birth weight rates are highly correlated with higher proportion of births to women with low education (.38), plurality (.48), rurality (.34), the proportion of women receiving no prenatal care (.34) and the Ob/gyn-to-females ratio (-.26). Associated with prematurity are high rates of single women (.32) and concentrations of first births (-.32). As anticipated, prematurity rates are correlated with increased low birth weight and neonatal mortality rates (.26 and .30). In addition, low birth weight rates are associated with a higher incidence of neonatal mortality (.30).

These correlations lend support to the research findings reviewed in Chapter Two and to the structural relationships posited in this study. In particular, these associations are evidence of the generally positive relationships among county sociodemographic risk factors with one another and with increased rates of sub-optimal birth outcomes, medical resources and improved birth outcomes. The magnitude and direction of the correlations of variables measuring low socioeconomic status, such as low education, high rates of poverty, and high welfare program participation rates suggest that macro community structures may have more to do with sub-optimal birth

outcomes than do medical care resources. In addition, these results also point to the need to estimate race-specific models due to the variation in direction and magnitude of the correlations across racial groups.

In the next section, the county structural model results are presented. The focus of this presentation is on the role of the IPO program in producing county rates of sub-optimal birth outcomes, and on the impact of other variables controlling for measurable risk characteristics.

The Structural Equation Models

County-level structural equation models were estimated to assess the effects of the IPO program on birth outcomes while holding the effects of important confounding variables constant. The equations estimated in this model for each outcome are the following:

EQ. 4: Prematurity = f(IPO participants + MIC projects + WIC participation + family planning + Medicaid enrollment + teenage childbearing + low education + single mothers + plurality + parity + poor households + AFDC participants + reproductive risk + No prenatal visits + abortion rates + Ob/Gyn-to-female population ratio + e)

EQ. 5: Low Birth Weight = f(prematurity + IPO participants + MIC projects + WIC participation + family planning + Medicaid enrollment + teenage childbearing + low education + single mothers + plurality + parity + poor households + AFDC participants + reproductive risk + No prenatal visits + abortion rate + Ob/Gyn-to-female population ratio + e)

EQ. 6: Neonatal Mortality = f(prematurity + low birth weight + IPO participants + MIC projects + WIC participation + family planning + teenage childbearing + low education + single mothers + plurality + parity + poor households + AFDC participants + reproductive risk + No prenatal visits + abortions + nicu utilization + Ob/Gyn-to-female population ratio + e)

The Lisrel VI statistical package (Joreskog & Sorbom, 1988) was used to estimate the parameters and standard errors for the system of recursive equations. Maximum likelihood was chosen as the most appropriate estimator because it produces parameter estimates that are statistically efficient. Covariance matrices were analyzed in order to facilitate the use of the chi-square test of the model fit.

Specifications and Statistical Checks

Because the literature on prematurity, low birth weight and neonatal mortality indicates that these outcomes are interrelated, the three-equation model was tested for the existence of correlated error terms across equations. This test for the appropriateness of a seemingly unrelated regression specification is easily accomplished in Lisrel by estimating a simultaneous system that allows equation errors to covary. These parameter estimates were small and not significant statistically, therefore, it was concluded that the model could be estimated as a hierarchical recursive system (Hayduk, 1987).

In the model specified, two parameters are constrained to be zero--the effects of neonatal intensive care

utilization on prematurity and low birth weight. This restriction renders an overidentified system of equations (Johnston, 1984). An overidentified model specification implies that there are more pieces of information in the data (i.e., variances and covariances) than are necessary to estimate the effects of the independent variables (Namboodiri, Carter & Blalock, 1975). Given this specification, a maximum likelihood chi-square statistics can be employed to evaluate the model fit. Conversely, in just-identified systems, this chi-square test would result in a value of zero with no degrees of freedom, and a p-value of 1, rendering the test meaningless. With a modest sample size (i.e., 67) and a model containing a relatively large number of parameters, there is always potential for problems of unstable standard errors. For this reason, the levels of reported statistical significance for the coefficients should be interpreted with appropriate caution.

A number of measures of model fit are presented in the results section that follows. First, the squared multiple correlation for each structural equation separately (i.e., for the prematurity, low birth weight and neonatal mortality equations) are presented. Next, the coefficient of determination for all structural equations jointly is reported. The coefficient of determination is a measure of the strength of several relationships concurrently. The

third measure of model fit, similar to the coefficient of determination though defined differently mathematically, is the adjusted goodness of fit index. As noted earlier, the chi-square test of the system is a measure of the appropriateness of the specified structure of the model. In essence, this indicator tests the null hypothesis that the structure predicting the endogenous outcomes could be due to chance. If the chi-square value is small with an insignificant p-value, the null hypothesis is rejected and we can conclude that the structure of this system could not be replicated by chance alone (Hanushek & Jackson, 1977).

The parameter estimates for the prematurity, low birth weight and neonatal mortality equations modeled separately for black and white birth data are presented in Tables 5-1 and 5-2. Both the standardized and the unstandardized coefficients are presented. These findings are discussed below by race and by comparing outcomes across racial groups. The significance of the parameter estimates are reported with t-values in Tables 5-1 and 5-2. It should be noted that when using the maximum likelihood function in Lisrel, the t-values should be interpreted using a Z-table of probabilities under the normal curve (Hayduk, 1987). However, with an N size greater than 60, the t-distribution approximates the normal curve, and the levels of significance for the z-value are very close to the levels for standard t-values. Specifically, under a two-tailed

Table 5-1: Parameter Estimates for the Prematurity, Low Birth Weight and Neonatal Mortality Equations Among Black Births, 1986-1988

Variable	Prematurity	Low Birth Weight	Neonatal Mortality
PROGRAMS			
IPO Participation	-.003 -.017 (-.116)	-.021 -.153 (-1.165)	.095 .181 (1.273)
MIC Projects	-1.026 -.080 (.618)	-.105 -.011 (-.098)	.890 .025 (.199)
WIC Participation	-.096 -.272 (-1.569)	-.044 -.170 (-1.098)	.188 .188 (1.136)
Family Planning	-.184 -.231 (-1.149)	-.109 -.186 (-1.050)	-1.076 -.481 (-2.540)
Medicaid	-.266 -.308 (-.884)	-.212 -.334 (-1.092)	.504 .207 (.632)
SOCIODEMOGRAPHICS			
Births to Teens	-.045 -.225 (-1.261)	.011 .077 (.486)	.122 .215 (1.265)
Births to women with less than 12 years school	.275 .669 (3.251)	.007 .024 (.121)	-.147 -.127 (-.608)
Births to Single Women	-.077 -.185 (-1.047)	.059 .194 (1.250)	-.162 -.139 (-.833)
Plural Births	.795 .374 (2.651)	.897 .573 (4.359)	.476 .080 (.483)
Births of with Parity of one	.085 .151 (.945)	.042 .101 (.717)	-.019 -.012 (-.081)
Poor Households	.213 .381 (1.108)	-.125 -.304 (-1.002)	.577 .367 (1.133)
AFDC Participants	.046 .033 (.096)	.510 .502 (1.656)	.307 .079 (.239)

Table 5-1--continued

Variable	Prematurity	Low Birth Weight	Neonatal Mortality
Rural-Urban Residence	-.133 -.169 (-.732)	.129 .224 (1.104)	-.461 -.209 (-.960)
MEDICAL FACTORS			
Reproductive Risk	.011 .012 (.087)	.044 .064 (.530)	1.063 .409 (3.192)
No Prenatal Visits	.085 .111 (.749)	-.133 -.237 (-1.819)	-.161 -.075 (-.512)
NICU Utilization Rates	-- -- --	-- -- --	-.026 -.057 (-.454)
Abortions per 1,000 women	-.014 -.038 (-.293)	-.037 -.139 (-1.222)	.003 .003 (.022)
Ob/Gyns per 1,000 women of childbearing age	.087 .007 (.040)	2.278 .244 (1.620)	-.478 -.013 (-.082)
BIRTH OUTCOMES			
Prematurity	--	.143 .195 (1.550)	-.276 -.098 (-.723)
Low Birth Weight	--	--	.214 .056 (.367)
Square Multiple r	.443	.570	.522
Coefficient of Determination		.853	
Chi-Square and significance		3.48 with 2 df (p=.175)	
Adj. Goodness of Fit		.981	
N		67	

Notes: The top number is the unstandardized coefficient; the second number is the standardized coefficient, the third number is the t-value. T-values of 1.97 or greater are significant at $p < .05$. -- indicates that the variables was not included in the model or it was fixed.

Table 5-2 Parameter Estimates for the Prematurity, Low Birth Weight and Neonatal Mortality Equations Among White Births, 1986-1988

Variable	Prematurity	Low Birth Weight	Neonatal Mortality
PROGRAMS			
IPO Participation	-.007 -.056 (-.311)	-.002 -.022 (-.129)	-.086 -.317 (-1.654)
MIC Projects	-.006 -.001 (-.011)	.327 .085 .708	-.074 -.008 (.056)
WIC Participation	.037 .044 (.239)	.048 .067 (.390)	.112 .063 (.322)
Family Planning	.078 .269 (1.260)	.010 .044 (.214)	.358 .596 (2.526)
Medicaid	-.102 -.323 (-.914)	-.013 -.049 (-.146)	.159 .243 (.622)
SOCIODEMOGRAPHICS			
Births to Teens	-.096 -.451 (-2.158)	-.025 -.145 (-.699)	-.209 -.476 (-2.039)
Births to women with less than 12 years school	.014 .104 (.413)	.077 .711 (2.975)	-.041 -.150 (-.514)
Births to Single Women	.083 .218 (1.071)	-.054 -.171 (-.882)	.251 .319 (1.408)
Plural Births	.142 .078 (.602)	.413 .275 (2.247)	.319 .085 (.583)
Births of with Parity of one	-.188 -.448 (-2.527)	.147 .425 (2.386)	-.217 -.250 (-1.095)
Poor Households	.032 .154 (.468)	-.044 -.261 (-.836)	.024 .057 (.161)
AFDC Participants	-.085 -.169 (-.546)	.101 .244 (.832)	-.411 -.394 (-1.167)

Table 5-2--continued

Variable	Prematurity	Low Birth Weight	Neonatal Mortality
Rural-Urban Residence	-.076 -.266 (-1.315)	.011 .045 (.230)	-.082 -.139 (-.627)
MEDICAL FACTORS			
Reproductive Risk	.168 .191 (1.246)	.117 .162 (1.100)	.520 .286 (1.609)
No Prenatal Visits	.017 .042 (.281)	.010 .031 (.218)	-.251 -.299 (-1.723)
NICU Utilization Rates	-- -- --	-- -- --	.001 .007 (.047)
Abortions per 1,000 women	.026 .196 (1.533)	-.005 -.049 (-.399)	.034 .125 (.894)
Ob/gyns per 1,000 women of childbearing age	-1.051 -.227 (-1.340)	-.562 -.147 (-.904)	-.627 -.065 -.345
BIRTH OUTCOMES			
Prematurity	--	.232 .282 (2.070)	.006 .003 (.020)
Low Birth Weight	--	--	.760 .303 (1.865)
Square Multiple r	.457	.515	.387
Coefficient of Determination		.797	
Chi-Square and significance		.54 with 2 df (p=.762)	
Adj. Goodness of Fit		.997	
N		67	

Notes: The top number is the unstandardized regression coefficient; the second number is the standardized coefficient, the third number is the t-value. T-values of 1.97 or greater are significant at p<.05. The symbol -- indicates that the variables was not included in the model or it was fixed.

hypothesis, t-values over 1.97 are significant at the $p < .05$ level, and values over 2.66 are significant at $p < .01$. Therefore, coefficients in these tables that have t-values greater than 1.97 are interpreted as significant at the $p < .05$ level. This level is selected as indicating significance out of convention. The next section discusses the results of estimating the model with the black birth data.

Impact of the IPO on Black Birth Outcomes

The squared multiple correlations for the individual equations show that a significant amount of variation is being explained in each equation. The low birth weight model explains the most variance in the rates of low birth weight for blacks, with a value of .57. The neonatal mortality model produced the next largest multiple correlation, explaining a full 52% of the variance. The total coefficient of determination for the model estimating black birth outcomes is .853 and the adjusted goodness of fit index is .981 (see page two of Table 5-1). Both of these values indicate a very good model fit for the data. The chi-square value of 3.48 with an insignificant p-value ($p=.175$) also indicates that the null hypothesis (i.e., the model structure is due to chance) should be rejected (Hanushek & Jackson, 1977). Finally, 44% of the variance is explained in the prematurity model. These squared multiple correlations provide further evidence that the

equations estimated are modeling some part of the true underlying structures that are producing county rates of sub-optimal birth outcomes.

Black prematurity

The first column of Table 5-1 contains parameter estimates from the model specified to explain rates of prematurity among black births. The standardized coefficient for the IPO (beta=-.01) indicates that the program is only marginally important in explaining prematurity rates. The lack of a statistically significant parameter leads to two alternative explanations. First, any impact that the IPO program (as measured by penetration or participation rates) is having on the reduction of prematurity rates among the black IPO population is too small to be detected at the aggregate county level. A second interpretation must be that the program is not having any significant direct impact on rates of prematurity. Stated somewhat differently, after controlling for important sociodemographic, program and medical factors, the IPO program (as measured) does not significantly (at least at the .05 level) reduce rates of prematurity among blacks. However, the program may be significant at the .20 level.

Variables other than the IPO that are significantly associated with county prematurity rates among blacks include: concentrations of births to women with low

education (beta=.69), and plural births (beta=.37). The positive coefficient for the education measure indicates that the larger the proportion of births to women with less than 12 years of education, the greater the proportion of black premature births in a county. Relative to all other variables in the model, education has the most pronounced impact on prematurity rates. The standardized coefficient for plurality indicates that, as expected, an increase in the concentration of multiple births is important in explaining the rates of prematurity among blacks.

Black low birth weight

Similar to the prematurity equation, the low birth weight equation for blacks indicates that IPO participation rates are not significantly related to county rates of low birth weight. The standardized estimate is -.15. This coefficient suggests, again, that the IPO program plays a statistically insignificant role in producing county low birth weight rates when other important variables are controlled.

In this equation, the only variable associated with rates of low birth weight at a significance level of .05 is plurality. Not surprisingly, increases in the percentage of plural births results in increased rates of low birth weight (beta=.57). Increases in prematurity rates are associated with increased low birth weight rates

(beta=.195) but this variable is not significant at the .05 level.

Black neonatal mortality

The results of the neonatal mortality equation for black births are similar to the prematurity and low birth weight equations with regard to the net impact of the IPO program. In particular, the IPO program does not significantly reduce neonatal mortality rates (beta=.18, t=1.27). Indicators that are significant in this equation are family planning participation rates and the proportion of women who have had a prior fetal death. Family planning rates are negatively related to neonatal mortality (beta=-.48, t=-2.54) which is interpreted as causing reductions in rates of neonatal mortality when all other variables are controlled. The proportion of women at reproductive risk is positively related to neonatal mortality (.41), but is somewhat less important than participation in family planning. As anticipated, the greater the number of women at reproductive risk, the greater the number of neonatal deaths.

In summary, the estimation of the black county structural model shows that the IPO program does not play a significant role in reducing sub-optimal birth outcomes among blacks at the county level. However, the proportion of women participating in family planning services does operate to reduce rates of neonatal mortality. This

variable is expected to operate on this outcome by reducing unwanted pregnancies, which reduces the number of infants born unhealthy or not well cared for after birth. In addition, this variable may be tapping some self-selection or motivation factor of the participating women. Specifically, in counties where more women utilize public family planning services, there are potentially more women who are concerned about their reproductive health, and who, therefore, will take better care of themselves when they are pregnant. The overall result would be better birth outcomes. The next section presents the results of estimating the county structural models with white birth data.

The Impact of the IPO Program on White Birth Outcomes

Table 5-2 presents the results of estimating the three-equation structural model for white birth outcomes. The squared multiple correlations for individual equations are .457 for prematurity, .515 for low birth weight rates, and .387 for neonatal mortality rates. In general, the specified model fits the black birth data better than the white births. The only exception is the white prematurity structural equation which explains slightly more of the variation than the black prematurity equation (.457 compared to .443).

As with the black birth outcome model, after controlling for other relevant variables, IPO program

participation has no statistically significant association with birth outcomes. Though the coefficient of determination for the white model is lower than the black model (.797 compared to .853). The chi-square value for the white model is also low (.54) and insignificant (p=.762), indicating a good model fit.

White prematurity

As noted above, the IPO program measure is not significantly associated with county prematurity rates (beta=-.05). The factors that do play a role in explaining rates of prematurity include the proportion of births that are to teens (beta=-.45) and the proportion of first births (beta = -.44). Contrary to expectations, white teenage childbearing rates and the proportion of first births are found to reduce the rate of preterm births. The impact of first births could be explained as a result of women taking better care of themselves when they are pregnant with their first child.

White low birth weight

Turning, to the white low birth weight equation, we see that parity of one has a positive impact on rates of low birth weight (beta=.42, t=2.38). This result indicates that parity plays a differential role on sub-optimal birth outcomes depending on race. This finding lends further support for the necessity of estimating race-specific

models.While the IPO program is not important in predicting county rates of low birth weight, the proportion of women bearing children who have less than twelve years of education, the proportion of plural and first births, and the rate of prematurity are significant predictors of this birth outcome. Not surprisingly, the education variable is positively associated with rates of low birth weight (beta=.71, t=2.94) and it the most important predictor included in the equation. This finding means that counties that have higher birth rates among non-high school graduates also have higher rates of low birth weight among the white population. This relationship is supported by the literature and is explained through the association of low education with poorer socioeconomic status, poorer health status, and reduced access to medical care.

Returning to the other important variables, higher proportions of first births are found to increase rates of low birth weight (beta=.42). This variable is the second most important contributor to low birth weight rates. Plural births are also found to increase the rate of white low birth weight with a standardized coefficient of .275. In addition, the higher the prematurity rate among whites, the higher the rate of low birth weight (beta=.28). These results are consistent with theoretical expectations discussed in an earlier chapter.

White neonatal mortality

Finally, we turn to the white neonatal mortality equation. The IPO program shows no impact on neonatal mortality. Similarly, the rate of low birth weight is not important in explaining white neonatal mortality. Indeed, the lack of association between low birth weight rates and neonatal mortality is inconsistent with most of the published literature. One plausible explanation for this non-relationship concerns the increased use of neonatal intensive care and its ability to improve survival rates of even very low birth weight infants (i.e., those weighing less than 3 pounds). It has been suggested that neonatal intensive care interventions have served to reduce neonatal mortality rates by simply moving these deaths into the post-neonatal period (i.e., the infants are kept alive for the first month through technical intervention, but often do not survive the entire year). It could be hypothesized, therefore, that the historical relationship between low birth weight and neonatal mortality is being diminished because of improved ability to keep low birth weight infants alive for the first four weeks of life.

Table 5-2 indicates that family planning participation rates increase rates of neonatal mortality for whites while higher concentration of teenage births decrease these rates. This is contrary to expectation. Compared to the black model results, family planning for whites has a

positive impact (beta=.59) and contributes more to the explanation of county neonatal mortality rates than do any of the other variables included in the model. A possible explanation for this relationship is unavailable at this time. Clearly the observed relationship between teenage childbearing and sub-optimal birth outcomes in the white population require further attention.

Summary of County Structural Model Findings

Two points are important to the discussion of these findings. First, it is important to note that many factors presumed to play a role in producing county sub-optimal birth outcome rates were not significant. For example, the measures of county poverty, AFDC participants, and rural residence all were expected to significantly increase these rates but did not. Secondly, and in response to the first issue, the modeling of these rates within a multivariate framework using aggregate data can produce results that may be at odds with less complex models estimated using individual or state-level data. For this reason, the lack of significance for some of the measures is not necessarily of concern. Instead, these findings shed greater light on the relative role of all the factors included. For example, medical resources are found to play no role in improving birth outcome rates. The characteristics that are important to policy discussions are maternal characteristics of education and age, as well as family

planning services. What is most important to note is the sign and magnitude of the coefficients in the equations. In particular, in every equation except black neonatal mortality, the IPO program operates to reduce rates of sub-optimal birth outcomes. Moreover, for white neonatal mortality, the IPO participation variable is significant at the .10 level. These findings are interpreted as evidence of the role played by the IPO in reducing rates of sub-optimal birth outcomes. The fact that these coefficients are not significant at the $p <.05$ level is a reflection of both the small percentage of birth to IPO women (relative to overall births) and the analytic technique used.

In addition to the part played by the IPO, plural births were found to have a significant impact on prematurity and low birth weight among blacks and on low birth weight among whites. What is surprising is that low birth weight rates were not found to increase neonatal mortality rates among blacks. This finding may indicate that low birth weight may be a proxy for other variables estimated in this equation, such as poverty or poor nutrition, and when these variables are included, the effects of low birth weight are attenuated. This is a hypothesis that can be tested in subsequent research.

The findings presented in this chapter indicate that, at the county level, the IPO program participation rates have no statistically significant impacts on aggregate

rates of sub-optimal birth outcomes. Because these outcomes are measured at the county level, it is possible that the true impact of the IPO may be masked in this analysis. To measure the impact of the program on birth outcomes among participants, attention is turned in the next chapter to a comparison of birth outcomes among the IPO population and the matched control and residual groups of non-participants.

CHAPTER SIX
MATCHED COMPARISON GROUP ANALYSIS
FINDINGS AND DISCUSSION

This chapter presents the results of comparing birth outcomes among the IPO and non-IPO participants. The effects of the IPO on birth outcomes for the program participants are examined graphically and statistically through the comparison of group (i.e., IPO, non-IPO, residual, and total state) rates of sub-optimal birth outcomes. The findings and implications of this and the county structural model analyses are presented in Chapter Seven.

Matched Control Group Comparison Findings

Birth outcome differentials among the IPO population, the matched control group and the residual group are assessed by plotting and comparing these rates over the time period between 1985 to 1988. In addition, the total state rates of prematurity, low birth weight and neonatal mortality for the racial group under study is included to provide a baseline of overall trends. The existing rates across the groups and rates of change over time are then compared, with emphasis on the differences between the IPO and matched control groups and over time.

Comparisons of Prematurity Rates

Figure 6-1 depicts the rates of prematurity for the three comparison groups and the total state for all races combined for the time period 1985 to 1988. The data show that prematurity rates among the IPO population (top line) are consistently higher than those among the matched control and residual groups. Moreover, these rates did not decline as rapidly as the control group rates between 1987 and 1988. Overall, therefore, the IPO program does not seem to be reducing rates of prematurity among IPO participants as anticipated.

Examination of the residual group rates indicate dramatically better outcomes than the IPO or the control groups. For example, the ratio of the average of the IPO and control group's prematurity rates to the residual group rates is approximately 2 to 1 for every year examined. This differential highlights the inherent relative risk status that characterizes the IPO population by virtue of their maternal and sociodemographic characteristics.

As demonstrated in the analysis presented in Chapter Five, the birth outcomes and the explanatory structure to explain these outcomes are very different for whites and blacks. Therefore, assessment of overall rates of prematurity, as presented in Figure 6-1, are expected to mask important trends in race-specific prematurity rates. Therefore, race-specific rates of prematurity for black and

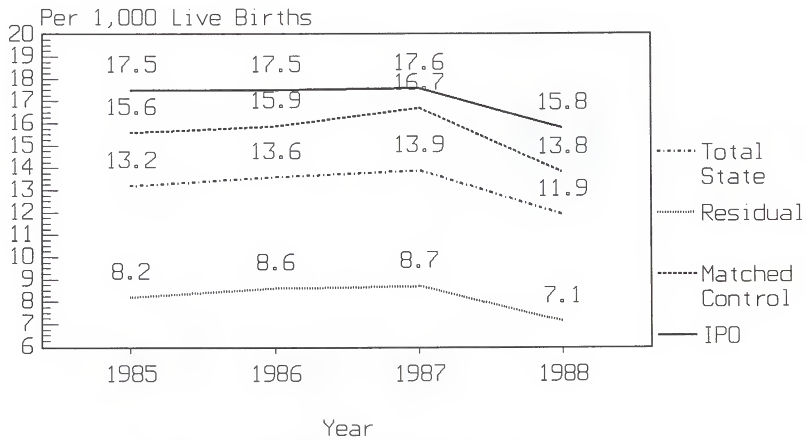

Figure 6-1: Prematurity Rates Among the IPO, Matched Control, Residual Groups and Total State for All Races Combined, 1985-1988

white births are examined. Figure 6-2 presents the rates of black prematurity over time for the three comparison groups and the state rates.

Examination of Figure 6-2 suggests that, although rates of prematurity among the IPO group increased slightly between 1985 and 1987 (22.1 vs. 22.9), their standing relative to the control group improved during that time. In 1987 the IPO prematurity rates were lower than the matched control group rates. However, between 1987 and 1988 the matched control group made gains (i.e., reductions in prematurity rates from 23.1 to 19.9) that surpassed the IPO group. Thus, for black prematurity, the IPO group had lower rates only for one of the four years examined. These findings suggest that IPO program participation for blacks has not reduced prematurity more than would have occurred had they not been in the program (i.e., as compared to the matched control group). The overall change in rates of prematurity for the IPO group is -2.4%. The overall change for the matched group was a reduction of 8.29%.

Turning to the white population, depicted in Figure 6-3, IPO participants have consistently higher rates of prematurity than the matched control group for the entire period under investigation. Moreover, the overall percentage decline among the control group is 13.5% compared to 13.1% for the IPO group. Again, these findings suggest that IPO program participants do not have a reduced

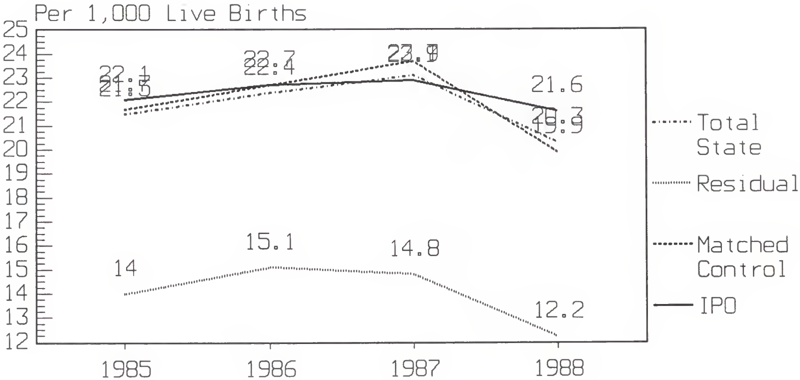

Figure 6-2: Prematurity Rates Among the IPO, Matched Control, Residual Groups and Total State for Black Births, 1985-1988

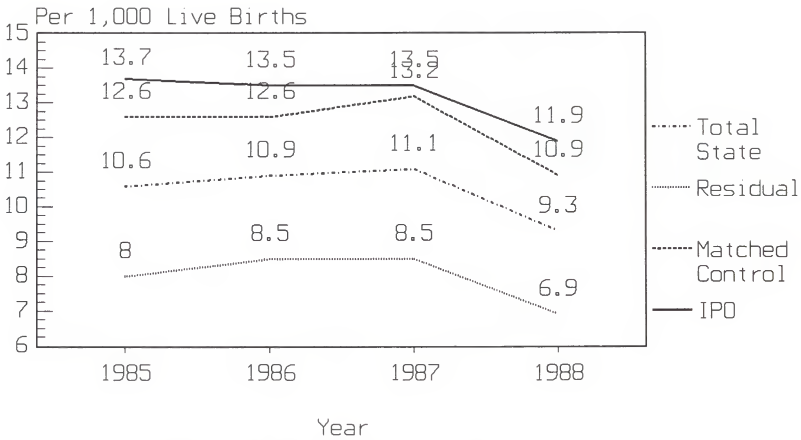

Figure 6-3: Prematurity Rates Among the IPO, Matched Control, Residual Groups and Total State for White Births, 1985-1988

incidence of prematurity relative to the matched comparison group. In fact, the rates of prematurity are higher among the IPO group than the control group, with the exception of black IPO rates in 1987 when they dropped below the matched group rates. Under the assumption that the matched control group is a reasonable proxy for a baseline group (i.e., had they not been in the IPO), birth outcomes among IPO women have not declined as anticipated.

One explanation of the lack of reductions in prematurity among IPO women is related to the inherent risk status of women enrolled in the IPO program. The women who participate in the IPO program may be sufficiently more at risk than non-participants, thus making the task of reducing prematurity more difficult. Some hypothesize, in fact, that increased risk (as determined by previous birth complications or poor outcomes) may be the motivating factor that compels women to enter prenatal care (Joyce, 1987). If this assertion is true, then one would expect the baseline risk among the IPO group to be higher than the matched control group. Again, this hypothesis involves selectivity bias considerations and cannot be assessed here, but it is an important consideration in the cautious interpretation of these results.

Low Birth Weight Rate Comparisons

Figures 6-4, 6-5, and 6-6 present the comparisons of low birth weight rates for the three comparison groups and

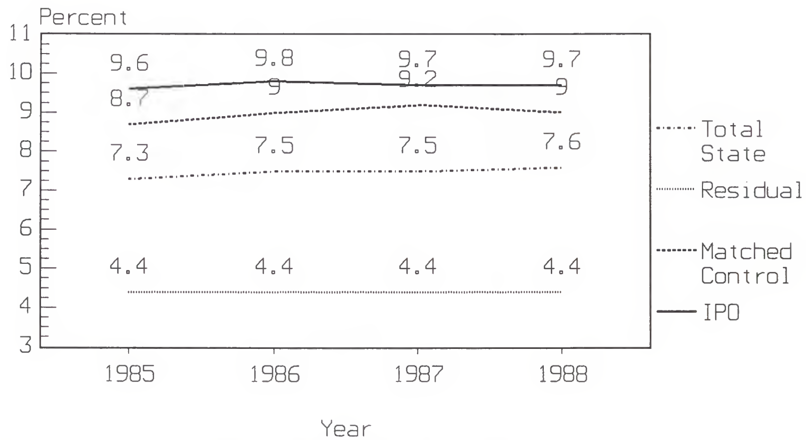

Figure 6-4: Low Birth Weight Rates Among the IPO, Matched Control, Residual Groups and Total State for All Races Combined, 1985-1988

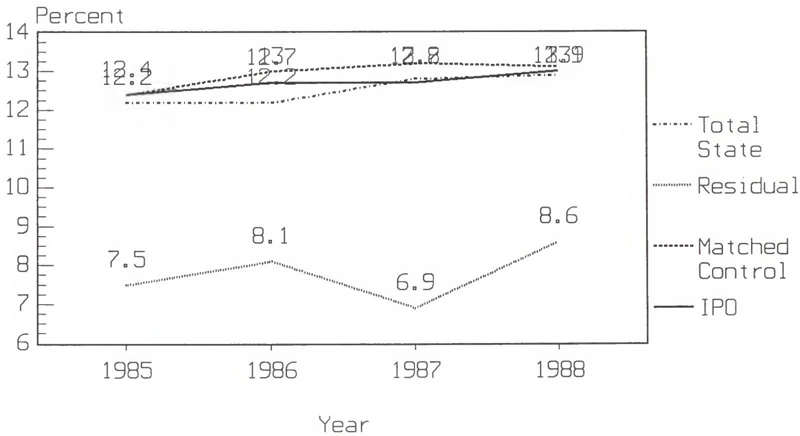

Figure 6-5: Low Birth Weight Rates Among the IPO, Matched Control, Residual Groups and Total State for Black Births, 1985-1988

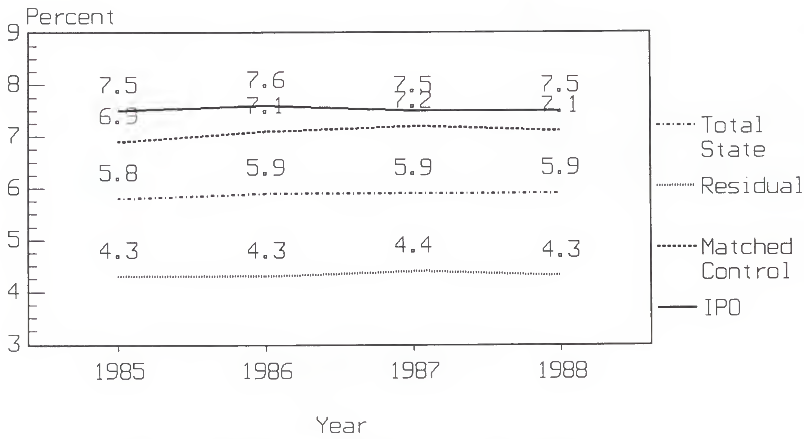

Figure 6-6: Low Birth Weight Rates Among the IPO, Matched Control, Residual Groups and Total State for White Births, 1985-1988

for the total state rates, overall and by race. The depiction of overall low birth weight trends in Figure 6-4 are very similar to the overall prematurity rate comparisons. The IPO group rates are slightly higher than the matched control group rates, and these differences remain constant over time. In fact, the rate for the matched control group declined from 9.2 to 9.0 between 1987 and 1988. The equivalent rate for the IPO group has been constant over the same time period.

It is important to note here that overall rates of low birth weight have changed little in Florida in the past decade. This fact is most strikingly indicated by the overall trends for the residual group--a constant rate of 4.4 for all years--and for the state. This flat trend is common across most of the United States (Institute of Medicine, 1985). However, Florida and the southeastern states have reported rates of low birth weight that are consistently higher, though relatively constant, than the U.S. average for most of the decade. Therefore, the population in Florida is expected to have higher than average low birth weight rates.

In Figure 6-5 the rates of low birth weight among the black population are reported. In contrast to the prematurity trends reported above, the low birth weight rate for IPO participants is consistently lower than the matched control group rate for all years except in 1985.

In this year, the low birth weight rates among the IPO and control group are identical. Even though the rates increased slightly over time, these findings provide evidence of the marginal influence of the IPO program on rates of low birth weight among black participants. The fact that the IPO rate drops below the state rate in 1987 further supports the hypothesis that the program operates to reduce the risk of low birth weight among the black population.

The trends in black low birth weight also indicate more variation over time than was apparent in the overall rates. Among the black residual group, in particular, the incidence of low birth weight has vacillated significantly, ending in a dramatic increase in 1988 of nearly 25% over the 1987 rate. The year before, the rate for this group declined by approximately 15%. The observed variation is at least partially explained by the small sample size for this group, resulting in potentially unstable rates.

For the IPO and control groups, change in black low birth weight has been minimal, yet significant, because of the positive direction; both groups have experienced increases since 1985. The IPO rate has increased at an average rate of 1.5% percent per year, for an overall increase of 4.8% since 1985. This finding contradicts the expected impact of the IPO program on participant outcomes.

Low birth weight rates among whites, found in Figure 6-6 are similar to the overall trends (i.e., relatively flat trend lines for all three groups). The IPO group has slightly higher rates of low birth weight than the matched control group. Although there is evidence of some convergence over time, in 1988 the IPO participants had a rate 5.3% higher than the matched group, compared to an 8% difference in 1985. These comparisons indicate that the IPO's effect on white low birth weight has been minimal.

Neonatal Mortality Rate Comparisons

More significant trends and differences in neonatal mortality rates are noted among the IPO and matched control groups. For example, the data in Figure 6-7 indicate that the IPO group achieved dramatic reductions in neonatal mortality between 1986 and 1987. Beginning at a level of 9.6 deaths per 1000 live births in 1985, the rate dropped over 40% to 5.7 in 1987, ending with a rate 24% lower than the matched control group. By comparison, the matched control group had a lower rate of neonatal deaths in 1985 and 1986, but this group did not experience the same magnitude of reductions in 1987. The rate dropped to 6.9 (23%) in 1987 and increased almost 19% in 1988. The equivalent increase for the IPO group was 8.8%, moving from 5.7 to 6.2 deaths per 1,000 births. The residual group has experienced less change in neonatal mortality over time (approximately 17.6%).

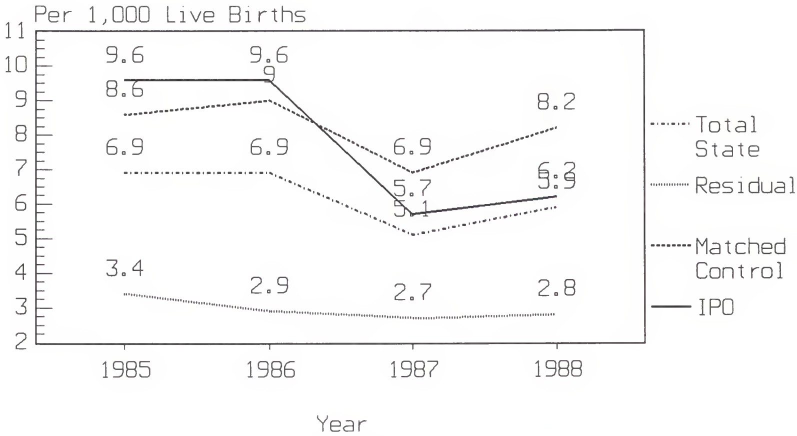

Figure 6-7: Neonatal Mortality Rates Among the IPO, Matched Control, Residual Groups and Total State for White Births 1985-1988

The relative comparison of group rates indicate that the IPO group has experienced more dramatic reductions in neonatal mortality than the matched group and the residual group. Furthermore, the rates of improvement have resulted in a switching of the relative position of the IPO and the matched control group. These results suggest strongly that the IPO program has had an impact on the overall rates of neonatal mortality among its participants. Specifically, if IPO participants were not enrolled in the program it is expected that this group's rates of neonatal mortality would have remained higher than those of the matched control group. Instead, the IPO group moved from having a rate 10.4% higher than the matched control group in 1985, to a rate that was 32% lower in 1988. Further, if the trend continues, the differential between IPO participants and a matched control group will increase in the future.

Among black births (Figure 6-8), the neonatal mortality trends are similar to the trends for the total population, only more volatile. Beginning with 14% higher rates of neonatal mortality than the matched control group in 1985 (i.e., a rate of 12.2 for IPO compared to 10.5 for the matched control group), the IPO group rates drop from 12.6 neonatal deaths per 1,000 live births in 1986 to 7.4 in 1987, a reduction of 41%. The matched control group, by comparison, experiences a smaller decline than the IPO group between 1986 and 1987 (22% vs. 9.4%, respectively),

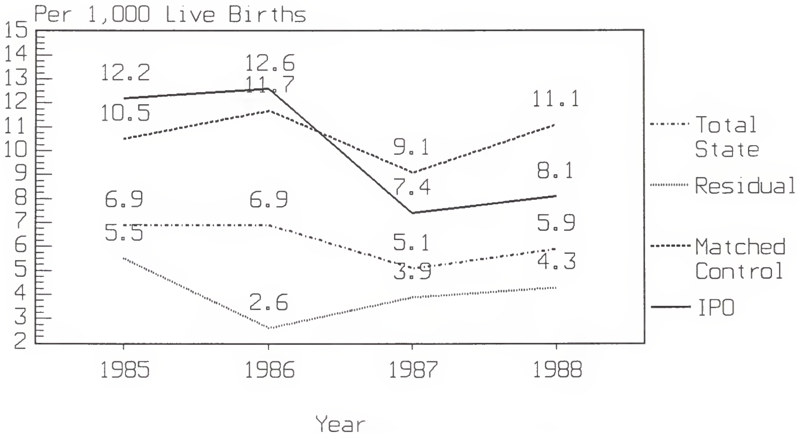

Figure 6-8: Neonatal Mortality Rates Among the IPO, Matched Control, Residual Groups and Total State for Black Births 1985-1988

and larger subsequent increases. Moreover, the residual group reports increasing rates of neonatal mortality since 1986 (i.e., an increase of 65% between 1986 and 1988).

Figure 6-9 presents neonatal mortality rates among white births. Again, IPO participants experience greater improvements in neonatal mortality rates over time, both absolutely and relative to either the control or residual groups. The rates of neonatal mortality for the IPO group dropped over 43% between 1986 and 1987.

These findings indicate the significant impact of the IPO program on rates of neonatal mortality among participants. Among black, white and overall rates, IPO participants experience greater declines in mortality rates than any other group between 1986 and 1987. In addition, though all groups are experiencing increases in neonatal mortality, the IPO rate is trending upward at a rate that is slower than or equivalent to the rate for the total state. These results would not be expected among a population of low socioeconomic status, high risk women in the absence of some well defined, targeted intervention. These trends show that the IPO has not only improved its participant's outcomes, but it has reduced them to levels that approach the rates for the total population in Florida.

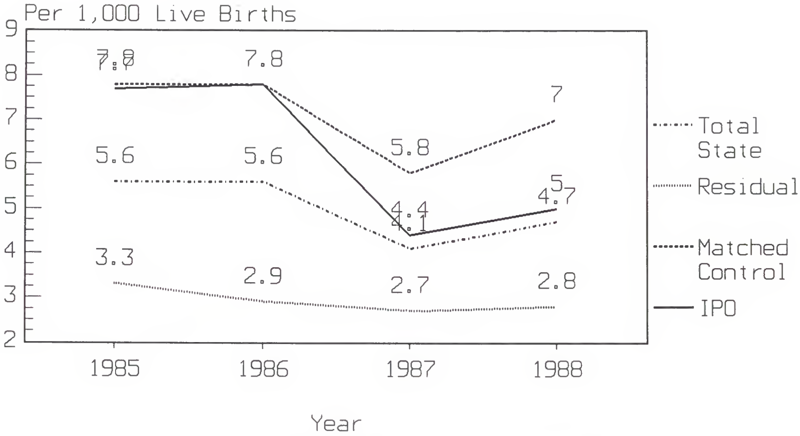

Figure 6-9: Neonatal Mortality Rates Among the IPO, Matched Control, Residual Groups and Total State for White Births 1985-1988

Discussion

In the group comparisons, the IPO program was found to have no impact on rates of prematurity, but was found to reduce rates of low birth weight among black IPO participants. Most significantly, IPO participation was found to cause dramatic declines in neonatal mortality among both black and white participants.

Because the county structural models, presented in Chapter Five, evaluated the impact of the IPO program on total population, as compared to participant-specific rates of sub-optimal birth outcomes, the results of that analysis are believed to underestimate the effects of the IPO program. This conclusion is based on several empirical observations. First, as found in the description of the IPO and non-IPO populations in Chapter Four, the proportion of white women giving birth who are IPO participants is less than .15. Therefore, the impact of the IPO program on participant birth outcomes would have to be pronounced to detect impacts at the aggregate county level. The same logic does not hold true for the impact of the program on black birth outcomes. Since IPO program participants account for a larger proportion of black women giving birth (nearly two-thirds), program effects at the aggregate level could be detected more readily. Therefore, the county structural model results provide attenuated estimates of the program's impact on the target population.

A second consideration in the discussion of these results is that the women who participate in the IPO program are typically at increased risk of poor birth outcomes due to their poverty status. Therefore, the task of reducing poor birth outcomes among this at-risk population is more demanding than it would be among a population of lower risk women. The ability of the IPO program to directly affect reductions in aggregate rates of low birth weight and indirectly to impact favorably on neonatal mortality rates indicates an important contribution of this program to statewide birth outcome improvements.

A third consideration is that the ability of the program to affect birth outcomes is dependent upon the health behaviors of the participants. Moreover, the socioeconomic and household environments of most of the participants are so deleterious to a pregnant woman's health, that interventions directed at women without improvements in the home situation are difficult at best. Therefore, for program effects to be evident, the program must be significantly improve the health or health behaviors of participants in order to overcome negative environmental influence. In light of the positive impacts found here of the IPO program on infant birth weight and survival, it could be concluded that the educational, nutritional and counseling components of the IPO program

can be effective means of reducing risk among the population served.

CHAPTER SEVEN
CONCLUSIONS AND IMPLICATIONS

The purpose of this research was to evaluate the impact of Florida's public maternity program, the Improved Pregnancy Outcome program, on rates of prematurity, low birth weight and neonatal mortality at the county-level and among participants. To achieve this, extensive individual-level and aggregate data from a number of sources were gathered and analyzed.

To avoid limitations inherent in the literature in this area (i.e., problems of confounding or aggregation bias), multiple exogenous factors known to impact sub-optimal birth outcomes were measured and controlled, and analyses of the data were performed at multiple levels (i.e., county and participant levels). Moreover, the methods of study were selected to allow for policy and research implications to be gleaned directly from the findings produced. The following sections summarize the results of these analyses and discuss the implications of the findings.

Summary

The results of both the county structural and matched comparison group analyses indicate that the IPO program is not having the expected impact on county and participant

rates of prematurity, low birth weight or neonatal mortality. At the aggregate county level, with important sociodemographic, program and medical factors controlled, the proportion of births to women who are IPO participants was found to reduce race-specific rates of sub-optimal birth outcomes, with the exception of black neonatal mortality. Although IPO participation was not significant at the .05 level, the negative coefficients were interpreted as contributing to declines in prematurity, low birth weight, and neonatal mortality among whites.

However, a number of other factors played a significant role in the production of county-level outcomes. In particular, family planning participation rates were found to reduce rates of neonatal mortality among blacks. Sociodemographic variables that increase the incidence of sub-optimal birth outcomes are the proportion of births to women with low education, the concentration of plural births, and, for whites, the proportion of women enrolled in family planning. In addition, the prematurity rate is significantly related to increased rates of low birth weight both among the black and white populations.

Important relationships identified in this study that were not anticipated include: a negative association between the proportion of births to women less than 16 and rates of prematurity and neonatal mortality (i.e., increases in the proportion of these women reduces these

rates); a negative association between the concentration of first births and prematurity; and, as just noted, a positive impact of family planning participation on rates of white neonatal mortality.

In addition, a number of factors that were anticipated to play a role in producing county rates of birth outcomes were <u>not</u> found to be significant. In particular, the proportion of poor households, the proportion of AFDC participants, rural residence, and the proportion of women with no prenatal care were all expected to increase rates of prematurity, low birth weight, and neonatal mortality. However, all of the parameters estimated for these factors were non-significant. The lack of association among these variables and the birth outcomes they were presumed to influence is believed to be the result of a number of factors. First, as noted in the data and methods chapter, the small sample size of 67 counties, as well as the small numbers of births in some of these counties (i.e., less than 30, even after pooling), could produce unstable standard errors, which would affect the statistical significance of the parameters in the model. A test of this influence, however, is not available.

Alternatively, the presence of non-significant relationships may be pointing to interactions among the variables. In particular, factors such as poverty and rurality may be found to operate to increase rates of sub-

optimal birth outcomes through their relationships with other, more significant, variables. For example, poverty and rural residence may influence birth outcomes by decreasing the proportion of women who complete high school--a measure that was found to be important in the county structural models. Considering the hypothesized simultaneous and interactive effects of the exogenous variables in these models, this explanation is entirely plausible. The test of this hypothesis was not undertaken in this analysis because of the explicit focus on the role of the IPO program. The analysis of the interactions among these variables will, however, be completed in future research.

In comparison to these county-level findings, results from the comparison group analysis provided evidence of the ability of the IPO program to reduce rates of low birth weight and neonatal mortality among participants. In particular, the data indicate that black IPO participants have better rates of low birth weight than the matched control group, and that both black and white IPO participants experienced greater declines and had lower rates of neonatal mortality than the matched control group.

Even though the rates of low birth weight in Florida have not declined in recent years, these findings suggest that the absence of the IPO program would possibly have resulted in more rapid increases in this rate than was

actually observed for the black IPO population. Moreover, the declines witnessed in neonatal mortality probably would have been only modest over the 1986-1987 period had the program not aided in the prevention of low weight births. Hence, the dramatic reductions in neonatal mortality found among the black population might not have been produced.

It is important to also note that the IPO program is not found to significantly reduce rates of prematurity among participants as expected. This result is particularly surprising given the implementation of the preterm birth prevention component of Florida's IPO program. The finding that the IPO participant prematurity rates are higher than the matched control or residual groups at every time period and for both races suggests that this component is not serving the function it was expected to. However, it could be argued that rates of prematurity in the state might, in fact, be higher if the IPO program was not in place. This arguement follows from national trends in increasing rates of prematurity.

These findings are interpreted as evidence of some moderate, though selective, impact of the IPO program on maternal and infant health in Florida. It is concluded that the provision of prenatal care through the IPO program reduces the risks of certain sub-optimal birth outcomes among participants, but that it does not do so at a

magnitude large enough to create reductions in these rates at the county level.

A number of IPO program components are hypothesized as contributing to the impact of the IPO program on low birth weight and neonatal mortality. Although specific components of the IPO program were not assessed for their unique contributions, a number of factors can be identified (and have been identified in the literature) as being conduits for the improved efficacy of the IPO program.

For example, the co-location of economic services and Medicaid workers in health departments is believed to improve program participation and therefore reduce the risks of poor birth outcomes (National Governor's Association, 1988). Co-location allows women entering the health department for a pregnancy test or prenatal care to apply for AFDC or Medicaid services at the same time. Florida has one of the best rates of co-location of eligibility workers in health departments in the country. It is reported that 60% of all health departments in Florida support full or part-time co-located Economic Services workers (National Governor's Association, 1988).

Along similar lines, the implementation of Medicaid eligibility expansions are also believed to have increased participation rates in Medicaid and the IPO program, and thereby decrease the risks of poor birth outcomes through the provision of prenatal care. Potentially the most

important change in this area has been the introduction of Medicaid's presumptive eligibility program. Under this program, pregnant women who are applying for Medicaid, and who are believed to be eligible, are provided prenatal care services under Medicaid for 45 days or until their application is processed. This Medicaid expansion is designed to prevent the delay of important prenatal care and has been noted in the health departments as getting women into care earlier. Florida was one of the earliest states to expand its Medicaid eligibility criteria in response to SOBRA. In 1987, Medicaid eligibility was expanded to cover pregnant women up to 100% of poverty and to include presumptive eligibility. It is reported that 68% of the more than 50,000 women who sought maternity care through the health departments in Florida were determined to be presumptively eligible and approximately 60% of these clients were subsequently enrolled in Medicaid or the Medically Needy programs (Florida Healthy Mothers, Health Babies Coalition, 1989). Therefore, the success of Florida's IPO program could be attributed, in part, to the effectiveness of the health department and economic services in reaching women in need by aiding their enrollment in key public programs.

Another factor critical to the effectiveness of the IPO program is the coordination of health departments and local hospitals. Though the IPO program does not fund delivery

services, a concern of IPO providers is to assist pregnant women in making delivery arrangements. Because Medicaid is the primary payor for a significant proportion of IPO births, and because Medicaid covers hospital and physician delivery costs, the aforementioned Medicaid enrollment procedures also assist in providing these delivery arrangements. For women not eligible for Medicaid, however, the confirmation of a delivery location can be difficult. For example, in some counties hospitals require a deposit in excess of $500 to be paid prior to delivery. For many low income women, this requirement excludes them from having delivery arrangements made and forces them to delay entry to a hospital until they are in active labor. At this point, few hospitals will refuse patients, even if they do not have the means of paying for services.

The critical component of these arrangements between participant and delivery site is the relationship developed between the county public health department and local hospitals. Typically, the better these relationships, the greater the availability of delivery services to IPO women. Moreover, the more flexible and secure these arrangements, the better the birth outcomes are believed to be as a result of transmitting medical records prior to delivery and the reduction of maternal stress (i.e., that due to not having a delivery site). Though these relationships have not been empirically tested, prenatal services in Florida

are organized with these issues in mind. Future research should, therefore, be designed to examine the impact of internal program arrangements, such as those just noted, on rates of birth outcomes.

Finally, because a major component of Florida's IPO program is the health, nutrition and preterm birth prevention education of its participants, this factor is expected to play a role in the impact of the program on birth outcomes. Directed at improving the knowledge of pregnant women concerning pregnancy and the prevention of preterm labor, improvements in birth outcomes are believed to occur as a result of improving the health and behaviors of participants. Empirical data on the efficacy of this component are not yet available.

Research Implications

This research goes beyond previous studies by examining a statewide program and by controlling for important public program, sociodemographic, and medical factors, including program and birth certificate records. Few studies are able to include measures of such a variety of factors, nor are many able to obtain individual or county data for an entire state.

The key implications for future studies in this area are the use of a multivariate framework, data available at the individual or aggregate levels, and the selection of a matched control group using simultaneous categories of risk

with which to match. The ease of interpretations of such data lend themselves to use in policy research.

A few caveats are in order at this time; particularly those related to multivariate analyses. Structural equation models utilizing cross-sectional data provide information that is heuristic in nature. Because the data are cross-sectional, they do not necessarily correspond to empirical change. Longitudinal data or panel studies would provide more accurate information concerning actual changes in health behaviors and sub-optimal birth outcomes among IPO participants.

Moreover, the use of birth outcomes among a group of non-participants with similar sociodemographic characteristics, while representing the best available comparison group in a non-experimental setting, is not a true representation of the baseline experience (i.e., what might occur if they were not in the program) of IPO women. The most troublesome problem is that of selectivity bias, a problem that is generally unavoidable in the area of program evaluations. This problem refers to the inability of researchers to adequately measure the characteristics of program participants that have selected themselves into the program (i.e., motivation, high risk, etc.). Though selectivity bias can be imperfectly addressed statistically in certain situations, the characteristics that self-select participating women into the IPO program were not measured

in this study. This bias, therefore, weakens the conclusions drawn from the comparison of the IPO and matched control groups.

With these caveats in mind, cautious conclusions strongly suggest themselves. After controlling for a variety of factors known to be correlated with both IPO program participation and poor birth outcomes, the IPO program is still noted as having an impact on sub-optimal birth outcomes among a high risk group of women in Florida. The preventive nature of the IPO program, the comprehensiveness of care, and the delivery of services at the local level are believed to coalesce to render the IPO an important public program, especially in an era of declining public services.

Policy Implications

Considering the short term medical costs and long term health and educational costs associated with poor birth outcomes (as noted in Chapter One), the findings reported here suggest that the benefits of the IPO program may outweigh its costs. Though estimates of the number of low birth weight births and neonatal deaths averted due to the implementation of the IPO program are not known, this study has shown that reductions in the rate of low birth weight among a high risk population in Florida have occurred as a result, in part, of the IPO program. Therefore, the program is noted as serving one of the functions with which

it was charged--that of reducing infant mortality through the provision of health education and adequate prenatal care to low income women.

In addition, considering the national goals of reducing the rates of infant mortality, including neonatal mortality, and low birth weight, especially among the black population, the IPO is also contributing to the realization of a national goal. As is reported in much of the literature on programs similar to the IPO, programs that provide prenatal care to women who would otherwise receive none are typically found to be of greatest benefit to those in greatest need -- women who are poor, black, and without insurance coverage.

Additional research on the effects of the IPO program is needed before definitive policy positions are taken on the funding of this program. In particular, careful assessment of the benefits of the IPO program--including the number of jobs it provides and the estimated number of neonatal deaths it prevents--must be calculated in dollar terms in order to be compared to the costs of the program. Moreover, the impact of the termination of the IPO program on the private prenatal care system, as well as on hospitals already over-burdened with uncompensate care, should be carefully considered when assessing the value of the IPO program.

Though all of these considerations come into play when public programs are prioritized in terms of funding, the value to society of the health of pregnant women and infants is something not commonly considered nor easily assessed. It should be argued, however, that despite the complex etiology of sub-optimal birth outcomes, the provision of public prenatal care to poor women at risk of these outcomes is one of the most effective and broad reaching solutions currently available to prevent the increasing incidence of low birth weight infants and neonatal mortality. Though we do not know exactly how many infants are saved or how many women will have improved birth weight, it is a safe assumption that, if Florida terminated IPO services to the more than 50,000 women it currently serves, the rates of sub-optimal birth outcomes in the state will rise significantly. The question to the state, as to society, is: do we want to pay now to prevent these outcomes or pay later for the consequences? This study was an attempt to provide some information relevant to this question.

APPENDIX A
DATA SOURCES

The individual-level data, including all maternal sociodemographic information, obtained from the birth certificates were obtained from the Florida Department of Health and Rehabilitative Services, Division of Vital Statistics in Jacksonville, Florida. All birth and infant death certificate data for the years 1984-1988 were provided in machine-readable form. The county sociodemographic variables of age, education, marital status proportions were created from these data by aggregating to the county level.

All of the program data were obtained from the Department of Health and Rehabilitative Services. The IPO and MIC data were obtained from the Division of Maternal and Child, Office of the IPO. The AFDC data were obtained from the Division of Economic Services, and the Family Planning data were provided by the Division of Family Health.

The neonatal intensive care data were gathered from a 1987 report on neonatal intensive care utilization and costs produced by Florida's Health Care Cost Containment Board (HCCB). The data analyzed by the HCCB were collected via survey of all hospitals in Florida with NICU's.

The number of women of childbearing age (i.e., 15-44 years) was taken from reports and intercensal estimates from the United States Census, 1980-1989.

The number of abortions performed were obtained from the Alan Guttmacher Institute (AGI) in Washington, D.C. These data were gathered from local sources by AGI staff, and are believed to be the most accurate data available. The data available through the Division of Vital Statistics are abortions reported by providers. Since this reporting is not mandatory in Florida, these data are severe underestimates of the number of abortions performed, and are therefore not utilized for this study.

APPENDIX B
DESCRIPTION OF RURAL-URBAN CONTINUUM MEASURE

1 = Core counties more than 1 million.

2 = Fringe counties more than 1 million.

3 = Core of SMSA 's 750,000 to 999,999.

4 = Fringe of SMSA's 750,000 to 999,999.

5 = Core of SMSA's 500,000 to 749,999.

6 = Fringe of SMSA's 500,000 to 749,999.

7 = Core of SMSA's 250,000 to 499,999.

8 = Fringe of SMSA's 250,000 to 499,999.

9 = Core of SMSA's 100,000 to 249,999.

10 = Fringe of SMSA's 100,000 to 249,999.

11 = SMSA's of 99,999 or less.

12 = Nonmet, adjacent counties size largest place 10,000+.

13 = Nonmet, adjacent counties size largest place 2500 to 9999.

14 = Nonmet, adjacent counties size largest place less than 2500.

15 = Nonmet, nonadjacent counties size largest place 10,000+.

16 = Nonmet, nonadjacent counties size largest 2500 to 9999.

17 = Nonmet, nonadjacent counties size largest place less than 2500.

APPENDIX C

PERCENTAGE AND FREQUENCY DISTRIBUTIONS OF BIRTHS ACROSS SIMULTANEOUS CATEGORIES OF AGE, EDUCATION, MARITAL STATUS AND PRENATAL VISITS BY RACE FOR THE IPO, MATCHED CONTROL AND RESIDUAL GROUPS, 1985-1988

APPENDIX C

PERCENTAGE AND FREQUENCY DISTRIBUTIONS OF BIRTHS ACROSS SIMULTANEOUS CATEGORIES OF AGE, EDUCATION, MARITAL STATUS AND PRENATAL VISITS BY RACE FOR THE IPO, MATCHED CONTROL AND RESIDUAL GROUPS, 1985

AGE, EDUCATION, PRENATAL VISITS	BLACKS						WHITES					
	SINGLE			MARRIED			SINGLE			MARRIED		
	IPO	Match	Resid	IPO	Match	Resid	IPO	Match	Resid	IPO	Match	Resid
Age <19 Education <12 Visits <7	7.6% 960	3.4% 799	- -	0.3% 37	0.2% 44	- -	3.7% 584	1.5% 705	- -	3.3% 525	1.7% 804	- -
Age <19 Education <12 Visits 7+	12.1% 1525	6.3% 1466	- -	0.5% 63	0.4% 90	- -	7.0% 1103	3.0% 1381	- -	8.3% 1304	4.6% 2210	- -
Age <19 Education 12+ Visits <7	1.7% 219	1.8% 274	- -	0.1% 16	0.2% 37	- -	.07% 105	0.5% 238	- -	.08% 131	.08% 361	- -
Age <19 Education 12+ Visits 7+	3.0% 380	2.1% 482	- -	0.3% 41	0.3% 76	- -	1.7% 263	1.3% 620	- -	3.0% 476	4.5% 2171	0.3% 171
Age 19+ Education <12 Visits <7	6.9% 876	5.2% 1206	- -	2.1% 262	1.7% 390	- -	3.5% 544	2.0% 956	- -	6.3% 996	4.0% 1909	- -
Age 19+ Education <12 Visits 7+	15.0% 1884	10.0% 2351	- -	6.1% 772	5.2% 1203	- -	6.5% 1026	3.7% 1787	- -	13.0% 2044	14.5% 6940	- -
Age 19+ Education 12+ Visits <7	9.7% 1228	8.6% 1997	- -	3.2% 404	5.4% 1261	- -	3.0% 479	2.6% 1261	- -	6.0% 948	9.0% 4291	1.5% 870
Age 19+ Education 12+ Visits 7+	20.6% 2603	23.8% 5556	- -	10.6% 1338	26.1% 6096	100% 1445	8.0% 1263	8.8% 4196	- -	25.1% 3955	36.5% 17890	98.2% 55520

1986

AGE, EDUCATION, PRENATAL VISITS	BLACKS						WHITES					
	SINGLE			MARRIED			SINGLE			MARRIED		
	IPO	Match	Resid	IPO	Match	Resid	IPO	Match	Resid	IPO	Match	Resid
Age <19 Education <12 Visits <7	6.3% 918	3.6% 808	- -	.3% 45	.2% 40	- -	3.1% 622	1.5% 721	- -	2.7% 539	1.2% 591	- -
Age <19 Education <12 Visits 7+	12.2% 1772	6.9% 1548	- -	.5% 73	.4% 85	- -	7.4% 1460	3.1% 1470	- -	7.2% 1413	4.3% 2074	- -
Age <19 Education 12+ Visits <7	1.2% 181	8.6% 192	- -	.1% 18	.2% 43	- -	0.7% 138	0.5% 220	- -	0.7% 134	.6% 298	- -
Age <19 Education 12+ Visits 7+	2.7% 393	2.1% 471	- -	.3% 43	.3% 74	- -	1.6% 320	1.6% 758	- -	2.6% 513	4.1% 1944	.3% 162
Age 19+ Education <12 Visits <7	6.8% 988	4.8% 1059	- -	1.8% 261	1.4% 316	- -	4.0% 746	2.0% 946	- -	5.6% 1094	3.1% 1478	- -
Age 19+ Education <12 Visits 7+	14.7% 2137	9.7% 2162	- -	5.0% 864	4.6% 1016	- -	7.4% 1452	3.6% 1729	- -	13.2% 2598	13.7% 6521	- -
Age 19+ Education 12+ Visits <7	9.4% 1359	8.0% 1769	- -	3.2% 465	5.0% 1115	- -	3.4% 666	2.5% 1182	- -	6.0% 1172	9.2% 4378	.2% 95
Age 19+ Education 12+ Visits 7+	23.4% 3395	24.7% 5488	100% 1562	11.0% 1598	27.1% 6014	- -	9.6% 1882	9.7% 4583	- -	25.1% 4935	39.1% 18568	99.5% 56887

1987

AGE, EDUCATION, PRENATAL VISITS	BLACKS						WHITES					
	SINGLE			MARRIED			SINGLE			MARRIED		
	IPO	Match	Resid	IPO	Match	Resid	IPO	Match	Resid	IPO	Match	Resid
Age <19 Education <12 Visits <7	4.7% 691	4.2% 1045	- -	0.2% 33	0.1% 35	- -	26.7% 514	1.8% 925	- -	2.1% 409	1.3% 680	- -
Age <19 Education <12 Visits 7+	10.4% 1541	8.3% 2073	- -	0.5% 69	0.4% 89	- -	7.1% 1373	3.6% 1827	- -	7.5% 1453	4.2% 2132	- -
Age <19 Education 12+ Visits <7	1.1% 159	1.0% 242	- -	0.1% 13	0.1% 15	- -	0.6% 116	0.5% 276	- -	0.6% 108	0.6% 315	- -
Age <19 Education 12+ Visits 7+	2.6% 381	1.9% 480	- -	0.2% 31	0.4% 87	- -	2.1% 406	1.7% 839	- -	2.7% 522	4.0% 2037	- -
Age 19+ Education <12 Visits <7	7.0% 1031	4.8% 1204	- -	1.6% 240	1.3% 335	- -	3.4% 651	1.8% 888	- -	4.1% 797	3.5% 1775	- -
Age 19+ Education <12 Visits 7+	14.0% 2051	10.0% 2455	- -	4.6% 680	5.2% 1302	- -	8.7% 1675	3.9% 1952	- -	13.7% 2630	13.9% 7009	- -
Age 19+ Education 12+ Visits <7	12.8% 1890	7.2% 1801	- -	3.3% 482	4.8% 1189	- -	3.4% 664	2.6% 1291	- -	5.5% 1062	8.6% 4328	0.6% 380
Age 19+ Education 12+ Visits 7+	25.7% 3804	22.7% 5651	- -	11.4% 1679	28.0% 6843	100% 1265	11.3% 2177	10.1% 5123	- -	24.4% 4708	37.9% 19189	99.4% 60694

1988

AGE, EDUCATION, PRENATAL VISITS	BLACKS						WHITES					
	SINGLE			MARRIED			SINGLE			MARRIED		
	IPO	Match	Resid	IPO	Match	Resid	IPO	Match	Resid	IPO	Match	Resid
Age <19 Education <12 Visits <7	5.4% 872	8.0% 1111	- -	0.3% 43	0.2% 43	- -	2.9% 679	1.8% 915	- -	2.0% 463	1.1% 570	- -
Age <19 Education <12 Visits 7+	11.4% 1852	8.1% 2013	- -	0.5% 76	0.4% 103	- -	7.2% 1684	3.9% 2018	- -	7.0% 1644	4.0% 2056	- -
Age <19 Education 12+ Visits <7	1.0% 160	0.9% 217	- -	0.1% 10	0.1% 24	- -	0.5% 129	0.5% 252	- -	0.5% 125	0.5% 268	- -
Age <19 Education 12+ Visits 7+	2.4% 387	2.1% 528	- -	0.2% 36	0.3% 80	- -	2.3% 535	1.6% 846	- -	2.5% 579	3.9% 2025	0.1% 88
Age 19+ Education <12 Visits <7	7.4% 1207	5.4% 1358	- -	1.9% 310	1.6% 410	- -	3.5% 819	2.0% 1038	- -	4.4% 1038	3.0% 1544	- -
Age 19+ Education <12 Visits 7+	13.6% 2203	9.0% 2245	- -	5.1% 827	4.9% 1223	- -	8.7% 2038	3.9% 1999	- -	13.4% 3148	12.7% 6534	- -
Age 19+ Education 12+ Visits <7	10.6% 1716	7.8% 1957	- -	3.2% 517	4.3% 1075	- -	3.6% 855	2.7% 1377	- -	5.4% 1261	8.4% 4327	- -
Age 19+ Education 12+ Visits 7+	25.3% 4105	23.0% 5743	- -	11.8% 1922	27.3% 6811	100% 1390	17.5% 4105	11.0% 5673	- -	8.2% 1922	0.5% 279	99.9% 61279

APPENDIX D
CORRELATION MATRIX OF STRUCTURAL EQUATION VARIABLES
FOR BLACK BIRTHS

APPENDIX D

Correlation Matrix of Structural Equation Variables for Black Births

	a	b	c	d	e	f	g	h	i	j	k	l	m
PROGRAM													
a IPO Participation	1.0												
b MIC Project	.05	1.0											
c Family Planning	.03	-.30	1.0										
d WIC Participation	.03	-.07	-.12	1.0									
e Medicaid	-.28	-.16	.58	-.10	1.0								
SOCIODEMOGRAPHIC													
f Age <16	-.23	-.10	-.08	.04	.06	1.0							
g Education <12	.08	-.03	.08	.44	.03	.45	1.0						
h Single	.20	.01	.10	.26	.13	.35	.59	1.0					
i Plural	-.03	.05	-.25	.25	.02	.08	.12	.01	1.0				
j Parity	-.21	-.05	.08	-.23	.10	.36	-.26	-.03	-.11	1.0			
k Poor Households	-.08	-.27	.62	.15	.85	-.03	.15	.25	.05	-.08	1.0		
l AFDC Participants	-.27	-.18	.71	-.16	.83	.16	.25	.18	-.16	-.00	.72	1.0	
m Rural-Urban Code	-.05	-.38	.58	.13	.50	-.04	.13	.08	-.24	-.09	.69	.53	1.0
MEDICAL													
n Reproductive Risk	-.01	-.11	.04	.31	.18	-.29	.13	.21	.04	-.31	.30	.14	.27
o < 7 Prenatal Visits	-.21	-.07	-.11	.07	-.18	.17	.11	.18	.08	.02	-.17	-.11	.10
p NICU Utilization	-.12	.29	-.06	-.22	.07	-.23	-.26	-.28	.09	.07	-.04	.01	-.24
q Abortions	.08	.23	-.13	-.18	-.09	.16	-.08	.06	.07	.27	-.19	-.14	-.34
r OB/GYNs per women	-.04	.32	-.27	.05	-.41	.04	-.05	-.17	-.07	.19	-.56	-.25	-.46
BIRTH OUTCOMES													
s Prematurity	.01	.02	-.23	.14	-.14	.10	.38	.10	.46	-.15	-.07	-.10	-.18
t Low Birth Weight	-.18	.05	-.25	.04	-.11	.29	.27	.07	.47	.03	-.19	-.00	-.25
u Neonatal Mortality	-.00	.02	-.24	.30	.22	.02	.05	.10	.29	-.14	.25	.02	-.01

	n	o	p	q	r	s	t	u
n Reproductive Risk	1.0							
o No Prenatal Visits	.13	1.0						
p NICU Utilization	-.09	-.32	1.0					
q Abortions	-.18	.10	.09	1.0				
r OB/GYNs per women	-.22	.21	.02	.05	1.0			
s Prematurity	.03	.12	-.10	.00	.02	1.0		
t Low Birth Weight	-.03	.04	.11	-.09	.24	.04	1.0	
u Neonatal Mortality	.45	-.15	.00	-.03	-.15	.12	.09	1.0

Note: Correlations greater than .24 are significant at the $p < .05$ level.

APPENDIX E
CORRELATION MATRIX OF STRUCTURAL EQUATION VARIABLES FOR WHITE BIRTHS

APPENDIX E

Correlation Matrix of Structural Equation Variables for White Births

	a	b	c	d	e	f	g	h	i	j	k	l	m	n
PROGRAM														
a IPO Participation	1.0													
b MIC Project	-.23	1.0												
c Family Planning	.39	-.30	1.0											
d WIC Participation	.20	-.35	.08	1.0										
e Medicaid	.18	-.16	.58	.46	1.0									
SOCIODEMOGRAPHIC														
f Age <16	.43	-.24	.47	.49	.51	1.0								
g Education <12	.46	-.32	.39	.54	.45	.72	1.0							
h Single	.25	-.09	-.04	.24	-.12	.26	.58	1.0						
i Plural	.16	.05	-.04	-.04	-.03	-.14	.12	.15	1.0					
j Parity	-.40	.27	-.33	-.38	-.35	-.61	-.67	-.35	.14	1.0				
k Poor Households	.45	-.27	.62	.62	.85	.62	.61	.06	.02	-.51	1.0			
l AFDC Participants	.11	-.18	.71	.38	.83	.45	.41	.02	-.04	-.31	.72	1.0		
m Rural-Urban Code	.35	-.38	.58	.59	.50	.44	.47	.04	.09	-.38	.69	.53	1.0	
MEDICAL														
n Reproductive Risk	.25	-.15	.31	.41	.36	.55	.39	.15	-.02	-.41	.46	.35	.49	
0 No Prenatal Visits	-.01	-.09	.27	.26	.37	.09	.23	.09	.27	.04	.33	.30	.38	
p NICU Utilization	-.07	.29	-.06	-.13	.07	-.10	-.23	-.13	-.02	.29	-.04	.01	-.24	
q Abortions	-.17	.23	-.13	-.18	-.09	-.21	-.25	-.22	-.05	.22	-.19	-.14	-.34	
r OB/GYNs per women	-.40	.32	-.27	-.32	-.41	-.12	-.27	.09	-.23	.35	-.56	-.25	-.46	
BIRTH OUTCOMES														
s Prematurity	.16	-.06	-.02	.06	-.20	-.10	.16	.32	.15	-.32	-.04	-.18	.06	
t Low Birth Weight	.15	-.08	.21	.24	.19	.08	.38	.21	.48	-.03	.23	.22	.28	
u Neonatal Mortality	-.05	-.02	.18	.17	.01	-.13	.04	.12	.14	-.13	.03	.07	.02	

	n	o	p	q	r	s	t	u	v	w
n Reproductive Risk	1.0									
o No Prenatal Visits	.26	1.0								
p NICU Utilization	.04	-.19	1.0							
q Abortions	.01	.01	.09	1.0						
r OB/GYNs per women	-.14	-.19	.02	.05	1.0					
BIRTH OUTCOMES										
s Prematurity	.02	.01	-.13	.11	-.23	1.0				
t Low Birth Weight	.20	.34	-.09	-.11	-.26	.26	1.0			
u Neonatal Mortality	.10	-.02	.05	.02	-.13	.30	.30	1.0		

Note: Correlations greater than .24 are significant at the $p < .05$ level.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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